UNION OF SOUTH AFRICA.

PROVINCE OF THE CAPE OF GOOD HOPE.

MARINE BIOLOGICAL REPORT No. 2.

FOR THE YEAR ENDING

30TH JUNE, 1914.

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To be presented to the Provincial Council.

Smithsonian Institution
AUG 24 1915
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National Museum

CAPE TOWN:
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[C.P. 6—'14.]

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THE PROVINCIAL SECRETARY,

SIR,—I have the honour to submit the following Reports dealing chiefly with certain marine biological questions which have arisen during the year in connection with fishing matters in the Cape Province. They include a review of the development of the fishing industry and recommendations as to the continuation of the marine biological survey with a view to further development, and an inquiry into the causes of the fluctuations in the fish supply, a question which has recently been much discussed. The alleged destruction of fish and fish spawn in the Berg River and at Knysna has been investigated in some detail. The investigations into the Crawfish question are continued and further information has been obtained. Observation on the habits of some South African fishes are recorded and the Snoek and allied fishes are dealt with in a special section. Lastly, some new species of South African fishes are described. In this I have been assisted by Mr. Wardlaw Thompson, F.Z.S., who also has contributed the first part of a useful catalogue of fish of the Cape Province. The original drawings have been done by Mr. I. Birbel, who, along with Mr. Cripps, has also assisted in the collection of townettings and other material.

I have the honour to be,

Sir,

Your obedient Servant,

J. D. F. GILCHRIST.

Cape Town,
30th June, 1914.

[C.P. 6—'14.]

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[C.P. 6—'14.]

UNION OF SOUTH AFRICA.

MARINE BIOLOGICAL REPORT.

I.—THE DEVELOPMENT OF THE FISHING INDUSTRY IN SOUTH AFRICA.

The history of the fishing industry in South Africa dates from a comparatively recent period. The aboriginal fishermen were, it is stated (Kolben), expert in their own particular methods. They used lines and hooks, with which they fished from the rocks; nets also were employed, and spearing, as well as the most primitive of all methods, "groping or tickling." Whistling or shouting during fishing operations was believed to be an improvement on these methods, as it ensured better results. Another development of this early fishing industry was brought about when the more adventurous and enterprising fishers swam out to the rocks situated at some distance from the shore, where they procured a more abundant supply, which they " take in their karosses or tie up in leathern bags and swim with the burthen on their heads." (Kolben.) The necessity for improved methods and extension of fishing operations to deeper waters was thus felt even in those early days, and was the beginning of subsequent enterprises which have led to steam trawlers making voyages of over 100 miles to distant fishing grounds.

With the settlement of Europeans in South Africa came improved methods, chiefly more effective and larger nets, better hooks, lines and boats. The interests of agriculture were, however, held to be of greater importance than those of the fishing industry, chiefly because the demand for agricultural produce was greater. Certain restrictions even were imposed by the East India Company on fishing operations.

With a growing farming population at the Cape, however, a market gradually arose for fish. The chief demand was for Harders (Mullet), and quantities of this were salted, dried and carried by wagon or cart to the various inland places. Seines or " trek-nets " were the chief fishing implements used

for the capture of the fish, and they have gradually increased in size and effectiveness since the time van Riebeck first imported them from Holland. It has also been found necessary to go further and further to sea in these fishing operations.

About thirty years ago a new and large market was opened up in Mauritius, where there was a great request on the part of the Indian population for fish ; the native African is not a fish-eater. It was found that salted and dried Snoek was admirably adapted for export, and gradually a large trade arose in this article.

The increasing white population and the opening up of the country by railways brought about an increased demand for fish. To meet this demand, there were several attempts to discover new fishing grounds and employ more modern and effective methods of fishing. In place of the open boats, seine nets and hand lines, which had proved inadequate, decked boats, long lines, drift nets, trawling, purse seines were tried. About the year 1892 an enterprising private firm fitted out a well-equipped vessel, the *Harry Mundahl*, for the exploitation of possible grounds further afield, but, unfortunately, the enterprise did not prove successful. Again, at Port Elizabeth, another attempt was made to introduce new methods by the importation of skilled fishermen from the North Sea ports, but for some reason this led to no practical result. Trawling experiments were also carried out by various private individuals and firms. Table Bay and False Bay were tried, as also Mossel Bay and Algoa Bay, with varying results. A small area was found in Table Bay suitable for trawling, and for many years the tugs in their spare time visited this ground with trawl nets. They occasionally caught a few soles, but the area proved to be so limited that trawling was ultimately abandoned. In False Bay and Mossel Bay the trawling experiments were unsuccessful. At Port Elizabeth (Algoa Bay) better results were obtained, but not sufficient to justify the employment of regular trawlers, and here also trawling was carried on by tugs in their spare time. Purse-seine netting was tried in and near Table Bay by an enterprising American firm, and this method of fishing proved very effective. Mackerel especially was caught in great abundance and exported to America. Partly on account of the opposition of the native fishermen and their representations to Government, and partly as the enterprise was not, on the whole, a financial success, it was not continued.

It was under these circumstances that in 1895 the matter was taken up by the Cape Government, and arrangements were made to carry out a general marine biological survey,

with a view to procuring further information as to the resources of the Cape Seas, the possibility of discovering new fishing ground and applying new methods. A vessel, the *Pieter Faure*, was specially designed and built for the purpose, and certain parts of the coast were carefully examined. The chief practical result was the discovery of certain new areas, in which large quantities of fish, including soles, could be procured by trawling. These regions were, however, at a distance of about 150 miles from the nearest port with railway communications, and this at first presented some difficulties, but, by the use of ice, it was demonstrated that the fish could be landed in Cape Town at a clear profit. Reports of the experiment were published, in order to induce private companies to take up the work. This was only too successful, and at first some of these enterprises came to grief. This in time righted itself, and there are at present eight steam trawlers, fitted with refrigerating apparatus, regularly engaged in the development of these new fishing grounds. The result is that the fish supply to South Africa has been about doubled, a special feature being that soles, formerly a rarity, are now supplied in abundance.

It is difficult, in the absence of full and reliable statistics, to trace the actual state and progress of the fishing industry, but some figures are available, from various sources, which may throw some light on the subject.

The figures of imports of fish into Cape Colony show some striking features. The countries from which the imported fish come are chiefly the United Kingdom, next in order being the United States, Germany, Holland, Belgium, Portugal, and other places, among which are Bombay and Hong-Kong. The maximum amount imported into Cape Colony was in the year 1902, when the total value was £327,413. In 1909 it was £77,605 for the Cape Province, and £170,583 for the Union of South Africa. The fish are chiefly tinned salmon, sardines, etc., a much lesser quantity of dried or cured fish, such as salted cod and ling, or fish fresh, partly cured and preserved in ice, such as Salmon, smoked Haddock, etc.

These quantities seem to be excessive and to indicate the necessity for further development of the South African Fishing Industry. It is true we may place over against them the quantities of canned and cured fish exported (chiefly Crawfish and Snoek), which in 1909 amounted to over £33,000 in value ; there is also a growing but somewhat erratic oversea export of fresh and frozen fish. It is practically, however, a negligible quantity, being at most only £716.

It may be many years before the balance between exports and imports in fish is reached, but there is no reason to believe

that some day this may not occur, or even that there may be a considerable export to Europe. It may be mentioned in this connection that some trial consignments of soles were sent by one of the trawling companies to London and Melbourne, where they were sold at a payable price. Difficulties in devising a suitable method for conveying these fish such long distances without their losing their delicate flavour, and the fact that good prices were obtainable in South Africa, prevented anything beyond the experimental stage.

A more pleasing feature of figures given under exports are those of increasing quantities of fresh or frozen fish sent inland from the Cape ports. They first appear for the year 1904, and show a gradual rise from £5,194 in that year to £81,684 in 1909.

Further statistical information is afforded by the return, procured by the Cape Government from 1897 to 1904, when unfortunately, owing to financial depression, they were discontinued. Summarised, the total catches for the Colony alone being given, they are as follows :—

Year.	Cwts.	Value.
1897	97,151	£44,674
1898	115,822	55,269
1899	99,547	52,624
1900	90,525	62,197
1901	90,921	60,744
1902	92,398	59,058
1903	90,232	67,985
1904	179,411	103,893
Average	100,007	63,318

Difficulties were encountered in initiating and carrying out these records, and the quantities can only be regarded as approximate. A fairly accurate estimate of the quantity of fish landed in the Colony may, however, be obtained from the average for these years, namely, about 100,000 cwts., valued at about £63,000.

The Census returns for 1911 afforded the next information concerning the fish supply. They are given for Cape Town, East London, Mossel Bay, and Port Elizabeth. The total amounts to 6,970,000 fish, valued at £89,166. It is unfortunate that the quantity is not given in weight of fish, but, from calculations from the Government statistics, it would appear that there are on an average about 60 Cape fish to a cwt. Calculated accordingly, the total quantity would be about 116,166 cwts.

It may be of interest to note here the return of fish landed in Natal, which has procured quantities and values since the year 1908. Summarised, they are as follows :—

Year.	Cwts.	Value.
1908	26,779	£28,513
1909	23,837	24,143
1910	20,961	23,194
1911	22,527	25,426
1912	23,389	26,206
1913	24,333	26,764
Average	23,637	25,706

It would have been of great interest to have obtained the quantities of fish landed by trawlers since their arrival in 1901. An idea of the quantity which it was shown could be procured, may be obtained from the fact that in 1899 the *Pieter Faure*, fishing for three months on a purely commercial basis, in order to demonstrate practically the value of the new fishing ground, procured 46,817 large fish (Kabeljauws, Stockfish, etc.), 83,320 small fish (Silverfish, Pangas, etc.), and 28,270 pairs of soles, or nearly 4,000 cwts. in all.

The Customs Department at Cape Town, since July, 1912, has procured returns of fish caught by the three trawlers, *Star of the South*, *Richard Irvine*, and *The Bluff*, working from Table Bay. These returns show that, during the year 1913, the three vessels landed at Cape Town 47,380 cwts. of fish, including Soles. If the fish landed by the other five trawlers now at work be calculated on this basis, the total annual catch of the regular trawlers now working will be about 125,116 cwts., reckoning the catch of one of those at half that of the others, as it is a small vessel. These figures may be considered as fairly reliable, as, on the return of the Cape trawler after each voyage, the amount of the catch is reported to the Customs Department. The fish procured by the trawler is shipped directly from the vessel to refrigerating cars and sent up country, only a small quantity passing through the local market, so that the catch of the trawlers is practically not included in the Government returns for 1897-1904, nor in the Census returns for 1911, which may, therefore, be taken as the approximate catches of Cape fishermen as distinguished from those of trawlers.

The following is a synopsis of the figures (in thousands) of fish caught in the Cape Province :—

Average catch of Cape fishermen for the years 1897-1904 (from Cape Government statistics) .. .. 100,000 cwts.

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Catch of Cape fishermen for the year 1911—
Cape Town, East London, Mossel Bay,
Port Elizabeth (from Census return) .. 116,000 cwts.
Catch of Cape trawlers for the year 1913—
(from Customs return) .. .. .. 125,000 ,,

The above considerations seem to indicate that the direction in which any further substantial development of the fishing industry of the Cape Province may be looked for is in the opening up of new though distant fishing areas, which have long been suspected to exist in the Cape seas. There is scope enough for improvement in the older established fisheries closer at hand, and this is receiving attention by Government, chiefly in the construction of new or improved fishing harbours and stations. For any rapid and serious advance, however, attention must be turned to the exploiting of the larger resources of the Cape seas. Certain areas have been explored, and have yielded the results indicated, but a great deal still remains to be done. This is indicated in the accompanying charts (p. 167), which shows the area surveyed on the part of the coast, where the chief trawling ground was found. The east and west coasts did not prove so promising as this region on the south coast, and there still remains here large tracts to the south and east of it, which are as yet unknown, and on which further good results will probably be found.

It has been said that enough has now been done on the part of the Government for the fishing industry in the opening up of these new fishing areas, and efforts at further progress may now be relaxed, leaving it to private enterprise to continue and develop the work. This argument was brought forward at the very beginning of the work of the *Pieter Faure*, and threatened at one time to bring it to a premature close, even before it had begun. The apparent reasonableness of this view has in many other instances proved a serious bar to progress. The facts of the case are, however, against it, and it is to be remembered that the object of private enterprise is to increase private prosperity, there being no desire to jeopardise this by showing the way to other private enterprises. Trawlers have no more desire to open up new fishing grounds for the benefit of the community than a diamond company has to exploit the mineral, in which they are interested, for the good of the whole.

The continuation of the Marine Biological Survey is also desirable for reasons other than the discovery of new fishing grounds. A knowledge of additional facts with regard to the habits and life history of fish and marine animals generally is urgently required in connection with purely practical, as

well as scientific matters. A few examples will illustrate this better than any general statement. Thus, it has been proposed to prohibit fishing in certain areas, thereby depriving fishermen of their only means of livelihood, it being alleged that their methods of fishing destroy the young and "spawn" of fish. The most contradictory statements are made by fishermen as to the facts of the case. The same is alleged concerning the "disturbance of the feeding ground" of fish. Certain small fish, including Crawfish, protected by law, are alleged to be different species from the larger forms which it is intended to protect. Again, it has been alleged that at certain times fish migrate along a definite course, and are driven off by fishing operations in those areas. The decrease, or alleged decrease in the supply of fish is attributed to certain methods of fishing, which, it is therefore urged, should be abolished, and not to natural causes, which there is reason to believe further investigation into the currents, temperature, etc., of the sea will prove to be the real factors at work. Some of these difficulties have already been solved by scientific investigation, but frequently the Government of the country when appealed to, is put in the position of merely weighing the unfounded statements of one interested party against those of another, for lack of such information.

[C.P. 6—'14.]

II.—AN ENQUIRY INTO FLUCTUATIONS IN FISH SUPPLY ON THE SOUTH AFRICAN COAST.

Most of the difficulties and problems which arise in dealing with fishery matters are in connection with fluctuations or supposed fluctuations in the supply of fish. Very often there is considerable doubt as to whether there has been a real fluctuation or not, and hence the basis of all fishery regulations is a system of reliable statistics, whereby it may be ascertained if there has been an increase or decrease, and to what extent. In cases where conflicting interests are concerned, it is nearly always possible to get as many conflicting statements on such points, in the absence of such statistics. The fisherman is also always inclined to take a pessimistic view of the prospects of his calling, and his lamentations as to the scarcity of fish are as frequent as those of the farmer as to the vicissitudes of the weather; both are doubtless to be discounted to a large extent as attributable to the precarious nature of the harvest of sea and land. Again, there is a natural tendency to look on the past in a more favourable light than the present, the "good old days" that are gone being to a large extent created in the present.

With all allowances, however, for these considerations there has been at times an undoubted and marked diminution or even partial disappearance of fish. In European seas, for instance, the herring fisheries may at certain times and places prove a complete failure. Sardines may practically disappear, causing immense loss, and even destitution among the fishing population dependent on the Sardine industry. These instances may be classed in one group and referred to more or less migratory fish. Another kind of scarcity or disappearance is connected with the more stationary species of fish, and is not of so sudden a nature, being rather an increased diminution throughout a number of years. Such, for instance, is the alleged diminution of flat fish in the North Sea.

Both of these have been experienced in South Africa. Thus the Snoek, which about 25 years ago occurred in vast numbers on the West Coast and was shipped in large quantities to Mauritius, more or less suddenly fell off in quantity to such an extent that the export trade in these fish almost ceased, and of recent years there have been numerous complaints of the increased scarcity of various kinds of fish found more inshore, particu-

larly those frequenting the tidal rivers. Unfortunately no continuous and reliable statistics are available, but there can be little doubt that this has occurred in the case of the Snoek, and the balance of evidence at least indicates that it has happened also in the case of other and more stationary fish.

The procuring of reliable statistics or other evidence of fluctuation is a primary requisite, but of not less importance, though less easily procured, is a knowledge of the true cause of such fluctuation. Very great damage may be, and, in some cases, probably has been done to the development of the fishing industry by dealing with the wrong source of the trouble. In countries such as South Africa, where primitive methods of fishing are giving place to more modern methods, the latter are, naturally enough, first condemned by the native fishers as the cause of the decreased supply. Whether, therefore, the cause is one which can be removed by legislation, or whether it lies in some uncontrollable physical or biological phenomena, it is of the utmost importance to ascertain its true nature as far as possible.

The object of this enquiry is: (1) to review the various causes alleged to be responsible for a diminished fish supply in South Africa, and to endeavour to estimate to what extent they are valid; (2) to direct attention to a possible cause of general and extensive diminution of the fish supply, peculiar to certain conditions in South African seas.

These alleged causes have been many and varied. They are as follows:—

1. Running of trains.
2. Firing of guns.
3. Use of dynamite.
4. Increase of shipping.
5. Netting in tidal rivers and lagoons.
6. Sea birds, particularly "Duikers."
7. Seals, Porpoises and Sharks.
8. Escape of injurious matter from wrecks.
9. Fresh water in tidal rivers.
10. Use of American purse-net.
11. Trawling.
12. Capture of immature fish.
13. Red water.
14. Obscure causes, such as earthquakes, cold currents, etc.

1. The fishing stations in False Bay (Gordon's Bay, Somerset Strand, Muizenberg, Kalk Bay, Fish Hoek and Simon's Town) are among the oldest and most important centres of the Fishing Industry in the Cape Province. Some thirty years ago the

fishermen in False Bay experienced a falling-off in the supply of fish, and it was suggested that the *vibration and noise made by trains* on the line, which runs practically on the sea shore from Muizenberg to Simon's Town, had the effect of scaring off the fish. It appears at first sight that the contention is hardly justifiable, and, indeed, was received with a good deal of incredubility if not ridicule by the public generally. It seems not improbable, however, that there may be some truth in the allegation of the fishermen, with reference at least to one kind of fish : this is the Harder or Mullet, which is one of the most important to fishermen on the stretch of coast line referred to. Its habits are well known to fishermen, and the presence of a shoal of these fish can be detected at a distance of some miles by the man stationed at the look-out, generally some elevated position on the mountain side. The shoal usually travel from the Cape Point side of the Bay northwards, passing Simon's Town, Fish Hoek, Muizenberg, and from there along the north side of the bay by Somerset Strand. When on the move along the shore, it has been observed that the fish are very readily alarmed, and make off to the open sea, in fact, as will be noted later, they can be driven off by the splashing of oars, and it is said that they can even detect the putting out of the trek boat, if incautiously done. It is not surprising, therefore, that, as has been observed by the fishermen, a shoal, for which they are waiting, is driven off by the vibration of a heavy train, only a few hundred yards distance.

There seems no reason to believe, however, that any permanent injury is done. It is true that it is just along this shore—Simon's Town to Muizenberg—that anglers also state that fish, such as Galjoen, Hottentot and other such species have, of recent years, been much scarcer, but, in judging of the value of this evidence, it is to be remembered that it is this locality that is chiefly visited by anglers, and the same complaint of scarcity of fish is heard from anglers at other localities, where no trains run, as will be seen later on.

2. It is also stated by fishermen that the *firing of heavy guns* from forts and warships, particularly at the naval station at Simon's Town, has a bad effect on fishing, but this does not seem to have been substantiated by any very definite evidence, and in any case is on a footing with the alleged damage done by train, in so far as it is a purely local occurrence. The explosion of a shell in the water might be supposed to have the same effect as dynamiting, but this does not seem to have been observed.

3. The *use of dynamite* for the capture of fish is an obvious cause of very serious destruction of fish life, and is universally

condemned. It need not, however, be dealt with in this enquiry, as it has long ago (in 1890) been prohibited by law, and there is no reason to believe such a wasteful method of procuring fish is indulged in to any extent, though now and again it may be employed in some of the up-country rivers and pools near mining operations.

4. The fish supply is said to have been affected in nearly all countries by the *increase of shipping*, especially of steamers, at the large ports, and South Africa is not an exception in this respect. In Table Bay more particularly, where the increase of shipping has chiefly occurred, the alleged diminution of fish has been associated with the increased traffic. This, like the running of trains and firing of guns, is of local occurrence, and, if fish are scared away, it is probably only to some other part of the coast.

5. Differing from these is the allegation that *netting*, especially at certain times and places, is responsible for such diminution. The consideration of this is of more importance than any of the above, as not only does it occur on a larger scale, but it can be more or less remedied. Objections to netting in South Africa were first put forward at Port Elizabeth in connection with fishing in the Zwartkops River, which opens into Algoa Bay near that town. The river is tidal for several miles inland, and is a favourite resort for anglers as well as netters. Netting was not carried on on an extensive scale, only one or two fishers catching fish for sale. It was alleged by the anglers that, in netting operations, quantities of fish spawn and young were destroyed, that the fish came into the river to breed, and were unduly disturbed by the netters, and that as a consequence fish were becoming scarcer in the river. The netters, on the other hand, stated that their operations were an actual benefit to the fish supply, as they frequently caught large sharks, one of which could cause more damage than all the netters together. They stated, furthermore, that there was no evidence of the diminution of fish and that the fish came out and in with every tide. (For further discussion of this question *vide* p. 75.)

6. The destruction of fish by *sea birds* must be enormous. Malagas, Duikers and Penguins live on fish, and, on the West coast of South Africa, where these birds breed without disturbance on the small islands off the coast, they occur in large numbers. They are protected from their enemies by being able to resort in the breeding season to these barren islands, on which no natural enemies, such as jackals or other carnivora of the mainland, can exist. They are now further protected by legislation, as they are most valuable guano producers. The chief offender amongst these birds is the "Cormorant,"

called the "Duiker" in South Africa. It is a well-known enemy of fish everywhere and, in some countries, rewards are offered for the destruction of these pests of the fishermen. Unfortunately, in South Africa, it is the best producer of guano, and thus arises the conflict between the interests of the fishermen and the farmers, who obtain from Government this valuable fertilizer at a rate less than the open market value. These birds are rigorously protected by law, landing on the islands being prohibited, especially during the breeding season. The fishermen seem to have, therefore good cause for their complaints, as this protection of the chief enemies of fish will naturally be detrimental to the fishing industry.

That the Duiker is a very expert fisher was very clearly demonstrated on one occasion at the Marine Laboratory at St. James. At times the bird seems to be affected by some illness, which causes it to seek the shore, and isolated individuals may be seen perched on some rock where they can be readily approached. On one occasion a Duiker was observed so affected that it could be picked up with hardly any attempt to escape. To discover the nature of its illness if possible, it was brought into the tank-room. Here it remained quite motionless and seemed to be in a dying condition. As it was thought that it might be revived in its natural element, it was placed in one of the larger tanks, which contained a number of fish, chiefly Dasjes, Harders and Sardines. Immediately the bird seemed to recover, and, to our astonishment, attacked the fish with the greatest vigour. By means of its webbed feet it was able to swim at a rapid rate, turning and changing its course with the greatest facility, apparently by the aid of its wings. The long neck was evidently of great utility in seizing the fish when within striking distance. It managed to capture several before it could be removed, which was done before much damage could be effected. It may be that such birds are in reality suffering from hunger. (See observation on Duikers dying off, p. 13).

The Duikers seem capable of concerted action in their fishing operations, and I am informed by Mr. Daneel, a member of the Fishery Board, that he has seen them surrounding a shoal of fish, rounding them up like a flock of sheep, in which crowded condition they could be more easily captured. They certainly seem to endeavour to drive the fish into shallow water, where they can be more easily secured. Thus at Knysna it has been observed (Henkel) that the birds form into wide circles, drive the fish into shallow water, and cause great damage. This is also stated by the fishermen, and has been observed on several occasions near the Marine Laboratory at

St. James. A typical case, of which the following notes were taken at the time, may be quoted :—On the 4th August, 1905, an unusually large number of Harders (*Mugil capito*), together with Bamboo-fish (*Box salpa*), were found in the rock-pools. Though small Harders are frequently found in such pools, those that appeared at this time were larger and more numerous than usual, and the Bamboo-fish, which are fairly large (about 12 inches), are never found normally in these places. There had been little or no change of temperature either before or after the occurrence. A very large number of sea birds, however, were fishing in crowds close inshore, and it seemed probable that the fish were driven ashore in their endeavour to escape from their pursuers. These birds were exclusively the common Duiker, which, particularly in a strong N.W. wind, as in this instance, come close inshore, perhaps to find shelter under the lee of the mountain. On another occasion a number of large Sardines (*Clupea sagax*) were found in the rock-pools, where they never normally occur. Some of the Bamboo-fish and Sardines were caught and placed in the tank at the Marine Laboratory. They showed no signs of injury or illness and lived for many months afterwards in the tanks.

There are, however, certain other considerations which may have some value in deciding to what an extent this destruction of fish-life takes place. It has been observed at various times by those in charge of the guano islands that there has been an unaccountable mortality amongst sea birds. Some time ago I was fortunate enough to have the opportunity of observing such an occurrence on "Seal Island," one of the islands situated off the coast of German S.W. Africa. I was informed by Mr. Muller, British Consul, stationed at Luderitzbucht, that the Duikers were dying off in large numbers on this island, and we visited it with the purpose of ascertaining the cause of such an occurrence. In the crevices of the rocks were numbers of dead birds, chiefly young, and here and there were others in a dying condition. The bodies of both dead and dying were in an emaciated condition, but there was no evidence of any disease. At a later date I was informed by Mr. Muller that it had been found that the cause of the mortality was the great scarcity of fish, which was known to have occurred at this time. It is not unlikely that similar occurrences observed on other islands on the West coast are due to this cause. While the scarcity of fish may not have been due to the excessive increase of these sea birds, it is obvious that such an increase, which could bring about a marked decrease of fish, would react in such a way as to bring the number of sea birds back to their normal numbers. In other words, the

increase of sea birds cannot by any system of protection exceed by a certain proportion the number of fish in the sea. We will adduce evidence later on to show that the scarcity of fish in this case was probably not due to the increase of the sea birds, but the occurrence seems to indicate that scarcity of fish would be as fatal to the existence of the sea birds as to the fishing industry and would result in their own destruction.

The following statement on the subject from Captain Jackson, late Superintendent of the Guano Islands, may be of interest :—" Mortality among fish, birds and seals occurs at certain periods on these coasts, but it is difficult to say in many instances what is the cause. Amongst birds, penguins appear to be more prone to disease than any other kind. We have had considerable mortality among these birds from time to time, the last of which occurred between two and three years ago (1902-1903), when the penguins came out of the water and dropped dead in large numbers."

7. The excessive increase of *Seals* is another alleged cause of a diminishing fish supply, and fishermen complain of this, even more than of the protection and increase of sea birds. Like the guano-producing sea birds, the seals are strictly protected by Government. A few years ago, when the seals had been protected for a number of years for a " knock down," they had increased to enormous proportions and, even yet, with a modified protection, they are very abundant (some zealous, but ill-informed, people in England, who advocate the protection of wild animals, state that the Cape seal is nearly extinct). Under this system of protection, these intelligent animals become so bold as to avail themselves of the fishing operations of the fishermen for a supply of fish. They are especially troublesome at the Snoek season. Snoek are powerful and rapid swimmers, and are probably not easily captured by the unaided effort of the seal. When caught on the fishing line, however, they are more or less hampered, and the seals soon learn to know this and avail themselves of the opportunity to seize and devour them. The fishermen were prohibited by law from killing the seal, and the only way to get rid of it legally was to come alongside of another boat, to which it might then transfer its attention. Frequently the fishermen had to come home in despair of getting rid of the unwelcome company.

At Seal Island, in Mossel Bay, the fishermen state that the fish is so scarce in the vicinity of this seal-frequented rock that it is useless to attempt any fishing in its neighbourhood.

As in the case of sea birds, it is doubtful if increase in the number of seals would be adequate to account for any grave

Seal Island, around which fish are scarce on account of the presence of seals and sea-birds. Penguins and about half-a-dozen large sleeping seals are seen in the foreground, duikers on rock in the distance.

diminution in the fish supply, as these animals, even more than the fishermen are dependent for their livelihood on an adequate supply of fish.

Porpoises on the east coast cause considerable damage to the fish supply, and sharks everywhere do the same. Porpoises are troublesome, particularly at Durban, and it has been found that if a few are shot and wounded they make for the open sea, taking all the others with them and there is no more trouble for some days.

8. The escape of *injurious matter from wrecks* is known to have caused more or less extensive destruction of fish. The best example of this is an occurrence which took place at Knysna. The Knysna harbour, or lagoon, is a large sheet of water, much smaller than Saldanha Bay, but, like it, shut off from the sea except for a comparatively narrow opening. On one occasion a ship, containing creosote for the sleeper factory there, was wrecked, and the oily substance escaped, spreading out on the surface of the lagoon. The effect was very marked, nearly all the living animals in the water being killed off.

9. An undoubted cause of the destruction of fish is the presence of *fresh water* in tidal rivers and lagoons. For instance, in October, 1904, a sudden and great fall of rain occurred after a period of drought in the Eastern Province and the whole of the sea water in the Zwartkops River, from the ebb and flow to the mouth (a distance of about six miles) was driven out to sea. After the subsidence of the water, many dead sea fish were found, and a large number of Cuttlefish, which live in the grassy salt-water pools of the river. Such an occurrence is said to be not uncommon in this region, and has been even more marked in the case of great floods in the other rivers of the east coast. At Knysna the fishermen expect an influx of sea fish after such an occurrence as Kabeljauw and other fish come in to devour the dead Cuttlefish. Cases of destruction of sea fish by fresh water are not unknown in other parts of the world.

A curious method of stating the same fact is the apparently anomalous allegation that the decrease of fish in South Africa is due to the increase of jackals, and that in the following way. Increase in the number of jackals necessitates the protection of sheep in a kraal during the night. The constant passing of the sheep to and from the kraal causes the gradual formation of more or less well-trodden paths ; by these paths the surface water flows off more quickly, deepening them, so that deep sluits are ultimately formed ; by these, the water, instead of soaking down into the surface of the ground, flows away quickly into the rivers, which are thus, in heavy rains, flooded

with fresh water, driving out the estuarine sea water and killing off the fish. The argument reminds one of the more familiar story of old maids and clover crops : Increase of old maids means increase of cats, which brings about decrease of mice ; decrease of mice means increase of bees, on which they feed, and increased number of bees ensures better fertilisation of the clover plant.

Such great floods, however, are not very frequent occurrences, and cannot be the cause of any great diminution in the fish supply generally.

10. Some 25 years ago an American schooner, the *Alice*, visited the Cape especially equipped with *purse-seine nets* for the capture chiefly of Mackerel, for which there was a great demand in America. The nets proved very effective, not only Mackerel but many kinds of fish being caught in very large numbers. As Mackerel only were wanted, the other fish were practically given away. The catching of such numbers of fish, by means of this kind of net, which was entirely new to the native fishermen, aroused suspicion that the method adopted was injurious to the fishing industry, and the fishermen made representations to the Government that the fish supply was being seriously affected. There being no independent evidence available that the fish supply was not diminishing, nor that the operation of the American nets were not the cause of the alleged diminution, a law was passed in 1890 (repealed in 1892) restricting the size of nets in such a way as to render it impossible to use the new net.

11. The development of the *trawling* industry was at one time jeopardised by allegations that diminution of the fish supply had followed the introduction of this method of fishing. As a result of the survey of the Government trawler the *Pieter Faure* large areas were found suitable for trawling. At the outset of this experiment the results did not seem promising, and no opposition was aroused. One native fisherman, indeed, undertook to "eat all the fish the *Pieter Faure* could catch." When, however, the Government trawler began to land fish in large quantities, objections cropped up on various sides to such a method of fishing. The supply of fish, it was stated, was falling off as a result of the trawling, and serious damage was being done to the "spawn" of the fish, which lay on the sea bottom, over which the trawl net was dragged. Representations were made to Parliament, and so serious did the matter seem that a Select Committee was appointed to enquire into the allegations. Fortunately a system of fishery statistics had been instituted, and investigations into the spawning

habits of the fish had been carried out at the Government Marine Laboratory. On reference to the statistics, no diminution in the supply was observed, and the work at the Marine Station clearly showed that the fish, whose spawn was said to be destroyed, had eggs and larvæ, which floated at the surface of the sea. The decision of the Committee was that the allegations were not substantiated, and they recommended the continuation of the exploratory work.

12 The continued *capture of immature sea fish* has been suspected to be the possible cause of diminution of the supply in South Africa as in other parts of the world, and about 20 years ago the mesh of the nets was regulated, being fixed as a minimum of $1\frac{1}{4}$ inches measured diagonally. This regulation had in view chiefly the protection of the Harder (Mullet) caught by means of seine nets. From recent investigation it would appear that this mesh is still too small to allow the escape of the immature fish. The capture of small fish by lines as well as by net is also suspected to be a source of danger to the fish supply. The matter is dealt with more fully in another part of this report (*vide* p. 75).

13. *Red water* is a phenomenon observed not infrequently in South African seas. It consists of masses of red-coloured water sometimes a mile or two in extent, at other times occurring only in small patches. In False Bay it may be seen, usually several times during the summer months, and presents a very remarkable appearance, being frequently of an almost blood-red colour. It consists of multitudes of *Noctiluca*, normally present in sea water nearly everywhere. At certain times, however, they increase enormously in numbers, when they can be seen to consist of the minute egg-like bodies, which in mass present the conspicuous red colour referred to. Such crowding together of these minute organisms appears to pollute the water, for when examined microscopically most were found to be dead. They are believed by some fishermen to be spawn of fish (*vide* p. 124), and have been described as "little round things like eggs, and they smell very nasty, like rotten pumpkin." (*Vide* report of Select Committee on the Fishing Industry 1898.) It has been observed that fish seem to avoid the red water, and fishermen do not care to fish in its vicinity. It is said that Mullet caught in it, decay very quickly, becoming quite decomposed if left ungutted overnight. One or two instances are known in which fish and other marine animals have been killed apparently by such polluting of the water. I am indebted to an old resident in Saldanha Bay for some particulars of such an occurrence at that place. He stated that on one occasion, the only one in his experience, about the

year 1907, the bay, which is almost land-locked, became filled with red water, known locally as " flower water." At the time there had been a north-west wind for some days previously. The fish in the bay were seen floating belly upwards in a disabled condition. Some of them were cast on shore in quantities at the end of the bay, in such numbers that they were " taken away in cartloads." Even the shell-fish, such as Mussels (*Donax serra* probably), Klip-Koes (*Haliotis*) were killed off in large numbers, apparently on account of the presence of large quantities of decaying organic matter.

Mr. McLachlan, at Stumpnose Bay, an open bay some distance to the north of Saldanha Bay, writing on 23rd February, 1904, supplied the following information : " About 35 years ago I saw a boat loaded with Geelbek fish landed here by one, Ian Solomon and crew, which they picked up at sea in the bay. The fish were found swimming, head above water, apparently in a stupefied condition. They filled their boat. These fish were found in dark red water."

Captain Jackson, writing 15th March, 1905, states that " about 15 or 20 years ago, the water of Table Bay, after darkness had set in, appeared like a sea of phosphorus. Many persons were taken ill, and I believe some died after eating fish, especially shell fish. I myself saw several baboons lying dead on the beach near Simon's Town with clam shells in their paws." The occurrence of such luminous water was doubtless due to the presence of large numbers of *Noctiluca* to which the " phosphorescence " of the sea is largely due. The last observation is, however, probably quite apart from the occurrence of " phosphorus " in Table Bay. The baboons may have been poisoned by eating the " white mussel " (*Donax serra*), which at certain seasons appears to be poisonous.

Another somewhat analogous occurrence is frequently observed on the West coast. This is the presence of what is known among the fishermen there as " dark water." On one or two occasions in the survey work of the *Pieter Faure* such water was observed, and proved on examination to contain diatoms in such number as to give a dark tinge to the sea, and this may be the explanation of the fishermen's "dark water." Unlike the " red water," it is not avoided by fish and, when it occurs the seine-net fishermen immediately put out their nets with confidence that they have a good chance of procuring a catch. At other times they seldom do so without some visible signs of the fish, though they occasionally make such " blind treks " at night when fish are scarce. The presence of these minute forms of vegetable life in the open seas, as is well known, tends to keep the water pure and favourable for

animal life, on account of the oxygen which is given off ; they are indeed probably the basis of the food supply for fish and all other animals in the ocean. Their presence in quantity, therefore would have the effect of attracting the fish, especially such fish as Mullet and Sardine, which again would be followed by the larger fish, which prey upon them.

It would seem, however, that in some circumstances, the presence of large quantities of vegetable matter in the sea may lead to organic decay and the suffocation of fish, as in the case of " red water." The following incident for which I am indebted to Mr. M'Lachlan, a resident of many years' experience in the fishing industry at Stumpnose Bay, seems to bear on this point. After narrating the case in which fish were found in " red water," he continues : " At another time I saw hundreds of large Steenbras fish, floating with their heads above water in a similar manner. The fishermen landed lots of them. I went afloat with a small boat, and to my surprise saw numerous Klip-fish and Hottentot-fish floating about in a stupefied condition. At the same time our fishermen picked up large quantities of Galjoen-fish on the beach at Schell Bay. In this instance, the water where the fish were found looked a thick greenish colour, with small particles of matter resembling a kind of mica. The night previous there had been a thunderstorm. My opinion was that very probably a thunderbolt had burst into the sea during the night, thus causing the fish to be stunned."

The " thick greenish water with small particles of matter resembling a kind of mica " is an accurate enough description of the appearance presented by the masses of diatoms in the sea, found in the survey of the *Pieter Faure* on the west coast on several occasions, and it looks as if the fish found were in a state of suffocation.

That masses of diatoms do decay in such a manner on the West coast will appear very probable from the incident related as occurring at Walfish Bay.

14. Under this last heading are included a number of very striking cases of destruction of fish attributed often to *submarine disturbances, cold currents, etc.* They seem to indicate a possible explanation of cases of general decrease in the fish supply in South Africa and are dealt with in detail. The most striking instances of this are recorded from the west coast, in and near Walfish Bay. The first case on record is an occurrence which took place at Swakopmund, a comparatively exposed seaport in German territory, a little to the north of the excellent and sheltered harbour of Walfish Bay. The following

is a translation of parts of a letter narrating the occurrences. It was from Mr. and Mrs. Koch to Mr. Bam, and was kindly handed to me by Prof. Schwartz. "In the year 1880, a few months before the flood (apparently from the river flowing into the bay), a species of large mussel, of the size and shape of a Caffir bean, white, blue grey and yellow in colour, was cast up alive on the beach. These Mussels had not been seen before nor were they ever found subsequently. On the evening of the 20th December, 1880, some native fishermen procured eels, which were unknown. On the following morning these were again found, and other fish were seen, the natives, however, fearing to make use of them on account of the peculiar colour of the water. At nine o'clock of the same day, it being spring tide, Mrs. Koch, along with the wife of Mr. Bauman, the missionary, visited the beach and saw hundreds of living and struggling ("zappelende") fish cast up on the sand by each wave. They were of all sizes and kinds, and included large Dog-fish. This continued for three days; the fish lay as far up as the sand dunes, a half to three quarters of an hour's walk behind the houses (there is a wide stretch of level ground, occasionally inundated by high tide, between the houses at Walfish Bay and the sand dunes, situated some distance further inland), and were heaped to a height of one or two feet. On Christmas eve it was almost impossible to proceed to the church on account of the odour, and it was scarcely possible to walk about without stepping on the dead fish, which lay between the houses close up to the doors. The *Lewis Alfred* was in the bay at the time, but the water was so blood-red ("blütig") *and smelt so badly that she left for Sandwich Harbour, where fewer fish had been cast up. The stench became so great that it would undoubtedly have caused illness had it not been for the South-west wind, which springs up almost every afternoon. It was useless to think of attempting to bury those millions of fish. Some English and Swedes attempted this in the case of the larger fish, but the fish, specially Harders, continued to be cast up anew. Everything of a white colour became black, even the deck houses of the *Lewis Alfred*, which had returned after three weeks to discharge her cargo. The odour of the dead fish had been felt on board at Usapf. After a few months the skeletons on the shore in the neighbourhood of the lagoon formed a pile five to six feet in height. Then began a plague of flies. It was only possible to drink a cup of coffee by keeping the hand in constant

* Mr. Bam remarks with reference to the colour of the water: "When I saw it it was inky, and must have been much darker in hue previous to my visit, which was several months after the occurrence."

movement ; they flew even into the cooking pots and, at mid-day dinner, a spoonful of sugar was placed before each plate to draw them off. We felt ill the whole day on account of the smell, and it is surprising that it could have been endured for six months. It was only in September that it became bearable.

" Shortly after Christmas of 1887 the second flood came, and about the beginning of 1883 the third. In 1887 the fish lay 20 to 30 minutes' walk behind the houses as far as the spring tides usually rise, and in 1883 only to just behind the houses."

Mr. Koch adds to his wife's narrative that no explanation of this occurrence was found till a few months previous to his time of writing (23rd September, 1900), when there appeared, near Pelican Point, a small island, about nine feet above the surface of the water. He describes it as a shapeless (" unfertige ") mass smelling strongly of sulphuretted hydrogen. There was at the time, he adds, a specially strong outburst of gas which killed off the fish far round about. The occurrence referred to is described in some detail by Mr. Waldron (Tr. Phil. Soc. S. Africa, vol. xi., p. 185).

Another instance is recorded from Table Bay by a writer in the *Cape Illustrated Monthly* in an article entitled " Fifty Years' Recollections of the Cape Colony." He states that " somewhere in the year 1837 millions of fish—Snoek, Mackerel, Stockfish and other kinds commonly found in Table Bay—were, owing, it was at the time believed, to the effects of a submarine earthquake, driven into the Bay, and, making for the shore, cast themselves upon the beach, where they lay inches deep all along the shore. This casting up of the terrified and dying fish continued for about three days, and the stench arising from the decaying mass was terrible. I was told that some of the poor blacks ate of the dead fish, and many died with excruciating agonies therefrom.

" I was told at the time that at this period large numbers of whales died from some unknown cause, and were cast ashore all round the Cape Point coast, and that the carcases were no good for the purpose of boiling for oil extraction. Perhaps the wholesale casting up of dead whales may account for the great number of whale bones to be seen so frequently on the littoral of Table and False Bays, used as gate posts, fences or beacons. I throw out this suggestion for the consideration of the curious in such matters."

On the 16th December, 1886, a case of mortality amongst sea fish occurred at Cape Receife. A number were observed by the lighthouse-keeper in the water in a " sick " condition. They seemed helpless and many of them were washed ashore. This

continued day after day for about a week, and various persons, hearing of the occurrence, came from Port Elizabeth to procure the fish for food. Nothing particularly striking as to the state of the weather or sea was observed at the time. The occurrence took place in 1886 and, speaking from memory (in 1904), the lighthouse-keeper states that the kind of fish affected were Kaapenaars (*Dentex argyrozona*), Dik-bekjes (*Pagrus laniarius*), a shark of about ten feet in length and, what struck him most, a large number of Papagaai-fish (*Hoplegnathus conwayi*).

On further enquiry at Port Elizabeth, confirmation of the occurrence was procured, and the lighthouse-keeper then stationed at Cape Receife was good enough to furnish the following entry from the log kept there: "16th December, 1886. Large quantity of fish and sharks washed up on the beach, mostly alive when washed up, but soon die. The fish are of various kinds, but mostly Barbers and a fish with a peculiar beak like a parrot." The two fish specially mentioned are shallow-water forms, viz., *Hoplegnathus* and *Galeichthys*. *Dentex argyrozona* is not a shallow-water form, but as it is mentioned only from memory and after an interval of 18 years, there may have been an error here.

Another case is recorded from East London. On the 26th September, 1903, a paragraph appeared in the *Peninsula Herald* stating that "tons upon tons of dead fish have lately been cast up upon the East London beach, varying in weight from 3 to 60 lbs. each. The coast was strewn with them from Christmas Vale to the Keiskama Mouth."

Enquiries were at once sent to fishery offices, temperature observers and others who might be in a position to confirm or augment this report.

Mr. Smith, Secretary of the Harbour Board, Durban, wrote: "We heard of the strange occurrence to which you refer, but as far as I am able to learn (and I have caused special enquiries to be made), nothing of a like nature has been seen on our coast. We have occasionally large numbers of Shad and Salmon thrown up, but that is the work of the porpoises and instead of being dead and limp and starved, they are very much alive and make an acceptable addition to the fishmonger's slab." The "Shad" of Durban is the "Elft" of Cape Town (*Temnodon saltator*) and the "Salmon" is the "Geelbek" of Cape Town (*Otolithus aequidens*).

Mr. L. A. Munn, Harbour Master at East London, reported: "The lowest surface temperatures recorded here during September were on the 10th and 11th respectively 50° and 51°; at about these dates a number of fish were noticed (by the men in fishing boats outside) dazedly swimming about at the sur-

face ; these were easily caught by hand. One such instance occurred in the river (Nahoon), when a Kafir boy simply took the fish out of the river from off the bank. Upon cleaning it the intestines were found quite empty. It was, however, cooked and eaten by a family near by. Unfortunately, I have not any reliable information as to the species of fish seen on the beach, mostly to the westward of Cove Rock, simply a general statement saying 'all sorts of fish.' On one or two occasions during the past 25 years quantities of fish have been seen on the beach as on the present occasion, and local fishermen are of the opinion that they have perished from want of food and abnormally low temperature of water. Such fish when examined have been invariably found to have empty stomachs. I do not think that the fish thrown away by the trawlers, as some allege, would account for such large quantities as those on the beach, and when similar occurrences took place earlier in the 25 years period there were no trawlers."

Mr. Wood, of East London, took some pains to ascertain the facts of the case. He writes : " I have met a Keiskama North resident, who saw the fish on the beach—those which were those probably alluded to in the newspaper paragraph you quote. As well as I can gather, the report first appeared in the *Daily Despatch* here, and came from a correspondent out Keiskama way. I am told it did not state fish had been cast up on the East London beach, and as far as I have learned nothing of the kind was noticed here. According to my Keiskama informant, sometime about the middle of September, hearing from a Kafir that there was a lot of fish lying about the beach, he took a few sacks and set out to collect the gifts the gods had sent. He found them by the score, a few hundreds altogether upon the mile or so of beach and, with the exception of a few here and there, they were more or less alive. Upon the sand washed by the surf they were lying about in a limp exhausted sort of condition, whilst in the rock pools they moved about as if dazed. There had been a heavy swell on for some days, but the water was warm. His young brother, who did the wading, said that it was quite nice and warm. This condition would correspond with what is stated in enclosed letter from one of the skippers of our local trawlers. The fish were chiefly Romans, Eels, Cape Salmon, Kabeljaauw, Dogfish, Ostracion, Blasops and a compressed fish of *chaetodon* outline, the latter being most numerous. He went back to get his sacks refilled, but the tide had come up in the interval and they were never seen again. Soles were not observed."

The enclosed letter referred to is as follows : " On September 8th, 9th, 10th and 11th, when trawling 18 miles east of East

London the water was quite warm to the hands ; the net and boards were also warm to the touch. My crew drew my attention to it. The depth of the water was 24 to 32 fathoms. I may mention that the fishing on these dates was very poor."

The Civil Commissioner at East London obtained reports from Field Cornets Willows and Holdstock. Mr. Willows reports : " The report in the *Peninsula Herald* is correct ; the sea, in which the dead and living fish were found in abundance, also extended east of Christmas Vale to the mouth of the Igoda River. Several days prior to the washing up of the fish strong south-east winds prevailed, and the general opinion is that they were the direct cause. However, this is an open question, owing mainly to the fact that some of the varieties washed up are known as " deep sea fish," and, therefore, not likely to be incapacitated by rough seas and, in addition, I noticed several eels. For several days live fish were caught in pools at low water, after the winds had abated, and the condition of the sea was fairly smooth. This gave rise to the supposition on my part that there was a possibility of the fish and eels having eaten a variety of sea weed, that at this particular time had a paralysing effect, thus causing them to lose control and be washed up by the force of the waves. The fish were eaten by natives and others without any ill effects About two and a-half years ago a similar occurrence took place along the beach in the vicinity of the Igulu River mouth."

Mr. Holdstock reports : " The fish were alive when washed up on the beach, as some were caught alive in shallow water. My opinion is that the fish were blinded with sand, which had been dispatched (?) off the harbour at East London, as there had been a heavy South-east wind blowing for four days, and these fish came ashore on the last day of the gale. I have not heard of any ashore to the east of East London."

Mr. H. H. van Breda, of Struis Bay, Bredasdorp, reported that after making enquiries he found that no such occurrence had been observed near Struis Bay within the last few months.

Mr. Regnart, of Jeffrey's Bay, writes : " Up to the present (23rd October, 1903) there have been no signs of fish being dead or paralysed on this coast. For the last three months a *very strong current* has been running to the west ; fish are plentiful, but will not feed. I believe I notified to your office in December last of a number of Kantonkel being washed out, some dead and others numbed with the cold. The water had been so cold for some days previously that it was impossible to bathe. On the 23rd most of the fish were washed ashore ; they were of large size, but only of the one kind. I go myself occasionally with the boats and should have noticed and reported anything exceptional."

Mr. William Jones, acting Port Officer at Plettenberg Bay, writes : " After diligent enquiry and search along the sea coast of the bay I have come to the conclusion that the mortality among the fish has not reached this bay. May not the marine eruption reported for the week ended 26th *ultimo* have some connection with the death of so many fish. Whilst the upheaval of the sea lasted it was awfully grand and those looking at it were relieved when it subsided as a boiling crater." The note referred to in the " remarks column " of the fishery returns is as follows :—" On the 23rd September, 1903, about three miles S.S.E. of Seal Cape across the bay towards Salt River, an upheaval of great height was seen about 4.30 p.m. It subsided exactly in the same place, showing great commotion in the sea, similar to volcanic eruption."

Mr. Donald Ben at Knysna Heads reported that " there were a few dead fish washed up on the beach in the early part of last month (September, 1903), but not sufficient to send a report on. The names of the fish washed up were Prunskopp of 60 to 80 lbs ; Dageraad, 3 to 10 lbs. ; Hottentot, 2 to 3 lbs. I have known these kinds of fish to die more or less every year from cold water, which is caused by a cold southerly current setting inshore with south-east winds. This cold current has no effect on deep-sea fish, only on rock fish."

Mr. McNaughton, Conservator of Forests, Knysna, reports : " It is no uncommon occurrence for fish to be washed up along the coast in an apparently dead condition. To a greater or lesser extent it happens annually. To my knowledge it has occurred periodically for the last fourteen years . . . . The fish if uninjured on the rocks are apparently quite healthy and recover their vitality in warm sheltered pools. The usual time of the year for the occurrence is late autumn (February-March) after heavy south-east gales. Some years ago the mortality was excessive, and this was accounted for by the fact that the south-east gales may have driven an iceberg to within a comparatively short distance from these shores, with the result that the water temperature was abnormal. The area affected, to my knowledge, is from Cape St. Francis to Cape St. Blaize."

At Mossel Bay on the 20th September, 1903, the captain of the trawler *Undine* reported to Mr. Wadner, manager of the fishing company there, that " last week the bottom of the sea was covered with dead and rotten fish, and at times the net was quite full of these. When the bag was opened and the fish fell on deck, the stench was abominable, and the skipper and the men handling the net felt so sick that they had to throw up

their food. In some instances only some of the big fish were found in the net. Dead fish are also floating about in the sea and the bay."

Mr. Wadner adds that "the cause of this extraordinary occurrence is difficult to tell. A cold mist has enveloped the bay and extended far out to sea on several occasions lately. I am told that that indicates icebergs not far away, and I should not wonder if a cold current originating from these has killed off a number of fish and driven the remainder to find warmer waters. Strange enough, the soles do not seem to suffer, but it may be that the current has swept above them."

Mr. McFarlane, at Hermanus, reported that "no dead fish have ever been cast up on our shores, nor have we seen dead fish floating about here at any time."

Mr. Avenell, of Somerset Strand, reported that no such occurrence was known at that place.

No fish was reported to have been cast up on the beach either at False Bay or Table Bay at this time.

Mr. Anderson, at Hoetjes Bay, writes: "No dead fish were cast up on our shore during September, but such a thing has happened previously, and I think the cause must have been at that time phosphorus water, a red thick water." (This refers apparently to the occurrence already described on page 18.)

The Fishery Officer at Steenberg's Cove states that "no dead fish were cast up on this part of the coast during September nor has there been since" (18th February, 1904).

The Fishery Officer at Paternoster also states that nothing was known of such an occurrence, and adds "this is a thing quite new to us. Long ago some few hundred Harders (Mullet) washed up on our beach; since then nothing of the kind has occurred."

Mr. M'Lachlan, at Stumpnose Bay, also states (23rd February, 1914) that nothing of the kind occurred there lately. After giving the two instances already mentioned he proceeds to state:—"Another instance was brought to my notice on the 20th March, 1901, by the local fishermen. While out snoeking about four miles off Schell Bay reef, they came across tons of dead Sardines floating in the sea, and hundreds of dead Sea Duikers were seen floating about at the same time. There were two currents that met together extending north and south. On the western side the water was blue, and on the eastern side the water was of a thick muddy colour, in which the dead Sardines were drifting, and my opinion is that when the sea water at some places becomes in such a morbid state,

it will cause the above results to all fish at the time confined to such waters."

Mr. H. A. Stigling, of Lambert's Bay, reported that "no dead fish of any description has been washed up here."

With regard to the occurrence at Knysna, I had recently (February, 1914) an opportunity of witnessing a phenomenon such as is described above as a normal yearly occurrence at this place. On the morning of the 7th, I was informed by Mr. Henkel that, while fishing the previous night, he noticed when renewing his bait that it felt very cold, and that the water had turned suddenly cold. His companions also noticed the striking fact. The fish ceased to bite, and only one Dogfish was caught subsequently. In the morning they were informed that a large fish (a "Blauer"—*Chrysophrys sp.*) had been found dead on the beach, and on further search a large Hottentot (*Cantharus blochii*) was discovered. These fish were respectively about 3 feet and 1½ feet in length. In the rock pools several Streepjes (*Box salpa*) were found dead. A series of temperature observations were taken on the same morning from near the village of Knysna to the "heads," where the lagoon opens by a somewhat narrow channel to the sea. The series was begun at the head of a side channel, the temperature of the air being 86° F. In this channel the temperature varied from 76 ·2° to 75° as follows : 76 ·2°, 76°, 75 ·8°, 75 ·5°, 75°, 75°, 75 ·5°, 75 ·5°, 75°. On entering the main channel little difference was at first observed, the temperature being as follows : 74°, 70 ·5°, 69°, 66°, 69°. At this point it was then observed that the lagoon was occupied with bodies of water of strikingly different appearance, and sharply marked off from each other. One was of dark blue, the other of slightly pale muddy, greenish colour. The fisherman in charge of the boat said that the former was warm water and the latter was cold, and was quite familiar with the condition. This was found to be the case. The boat was moved to the dividing line and the blue water was found to be 72°, while a few feet away the green water was 63 ·5°, a difference of 8 ·5°. This mixed water was then passed and thereafter, up to the sea, it was a constant temperature of 60° in the three observations taken at intervals of about half a mile. A number of seagulls were observed at one place and the fishermen said we would probably find some dead or dying fish here. One was at last seen floating belly upwards in the water and moving its fins slowly as if in a stupefied condition. On being touched it struggled and dived into the water only, however, to come up again shortly. The return journey was made by the main channel sometime after the tide had turned, setting in strongly into the lagoon, and the following

temperatures were observed from the Heads to the jetty at Knysna : 60 ·2°, 60 ·2°, 60 ·2°, 60 ·2°, 61°, 61 ·2°, 61°, 61 ·2°, 61°, 61°, 61°, 61°.

For some four or five days previous to the occurrence there was a fairly strong south-east wind and, on the day immediately preceding (Friday), it blew very strongly. On the day succeeding the above observation a north-west wind sprang up, and it was then found that the water in the lagoon (at high tide) was quite normal (72°), though at sea beyond the Heads the temperature was still 60°. From the signal-station at the Heads the cold water (recognised by its colour) could be seen, stretching along the shore in both directions as far as the eye could reach, while, at about a distance of two or three miles out to sea, the warm water (blue) could be seen with the same sharp line of distinction between them as observed in the lagoon. The signalman had noted the occurrence of the cold water and, on visiting the beach on Saturday, had observed " thousands of dead fish." On Sunday I could find only a few (about half-a-dozen) of these, the rest having been washed out by the tide, or eaten by sea-birds. The signalman further stated that such occurrences were frequent in January and February, and the dead fish could easily be seen at sea from his look-out, and that the cold water appeared as a muddy-looking band, stretching along the shore, as in the present instance. It appeared generally after a continuous or strong south-east wind, which he states blows along the shore, but is more associated with the direction of the inshore current ; this, he says, is usually from west to east, but, with cold water, it is reversed and flows to the west. This westerly current is usually associated with south-east winds, but not always, as he has observed occasionally a strong westerly current of cold water with no accompanying south-east wind. This easterly current is always warm.

The species of fish affected by this cold current is of significance in this enquiry being mostly shore-frequenting forms, such as Poeskop, Hottentot, Roman, Dasje, Dageraad, Michael or Red Stumpnose, and the Kraai-bek (*Chrysophrys sp.*, *Cantharus blochii*, *Chrysophrys cristiceps*, *Sargus capensis*, *Chrysophrys gibbiceps*, *Hoplegnathus conwayi*). The species not affected include Kabeljaauw, Bontrok, Seventy-four (here called silver fish), Galjoen, Harder, etc. (*Sciaena hololepidota*, *Sargus cervinus*, *Dentex undulatus*, *Dipterodon capensis*, *Mugil spp.*)

Whatever the origin of the cold water may be, it apparently comes up from the lower or deeper regions of the sea, and would thus cut off the rock and shore-frequenting

forms, which are mostly bottom feeders, while the surface-frequenting forms would be able to resort to the warmer surface water. The presence of patches of warm (blue) water in the river is apparently due to some of this normal sea water being cut off by the upwelling of the colder water along the shore. It has been observed further that, to escape the cold water, the shore forms come crowding into the lagoon, and seek out the warmer and shallow waters. That this is of frequent occurrence is shown by the fact that the fishermen find the best catches in these places during the presence of the cold water. The continuance of the cold inset would, of course, thus lead to a still greater mortality in the lagoon and, a few years ago, many fish were washed ashore dead and heaped up in great numbers on the banks of the lagoon.

The following notes on a case of extensive destruction of fish at the " Kommetje," a small basin to the south of Hout Bay, were taken at the time of the occurrence. " On Thursday, 3rd May, 1905, a telegram was sent from Mr. Runciman, M.L.A., Simon's Town, stating that great quantities of fish were being found on the beach between Hout Bay and Slangkop. One of the fish found, a large Galjoen (*Dipterodon capensis*), was forwarded at the same time. It showed no signs of disease and was in excellent condition. On visiting the locality, undoubted evidence was found that there had been extensive mortality among the fish. The report of the occurrence had reached neighbouring farms and villages, and the beach was being diligently searched by coloured people for further spoils. One farmer testified that he had seen some dead though fresh fish on Tuesday night, others being alive and floundering in the water in a dazed condition ; one large Galjoen he caught with difficulty swimming about in the water. He stated that many more fish were found on the following day, a few at a wreck but most on the " long beach " near Klein Slangkop, a mile or so from the wreck. All the witnesses were of opinion that the death of fish was due to the escape of some injurious matter from this wreck. The ship had come ashore immediately before the occurrence and was laden with general merchandise, including dynamite, cyanide, gun-cotton, soap, etc. All the dynamite was safely taken off, and there had been no explosion, which might have accounted for the dead fish. The beach in the neighbourhood of the wreck was strewn to some extent with pieces of soap and gun-cotton. One fisherman was certain that the injury to the fish had been caused by their eating the soap, the effects of which he alleged were to stupefy them temporarily. He said he had found pieces of soap and gun-cotton inside the dead

fish he had opened, and had also found the marks of the teeth of the Galjoen in pieces of soap. The stomach of a Galjoen I examined contained no soap or gun-cotton, and the pieces of soap seen had no marks on them which might not have been caused by dashing against the rocks. This same fisherman, who lives near the beach, had first seen some dead fish on Monday afternoon, but most on Wednesday, when three or four cartloads (each of about 300 to 400 fish) were taken from the beach, there being about a thousand fish in all. They were mostly bought by Jewish fishmongers and sold in Cape Town, and no injurious effects were reported from the consumers. The fisherman himself had eaten them without any ill effect."

The fish were mostly Galjoen, many of them exceptionally large, and Hottentots (*Cantharus blochii*). Klip-fish (*Clinus spp.*) also occurred among them, and large white Steenbras (*Pagellus lithognathus*) and a few Dogfish. One beach-searcher also stated that there were some large Kabeljaauws (*Sciaena hololepidota*).

The temperature of the water on Friday was 57° F., but one witness stated that on Monday he noticed that the water was particularly cold. No great change had been observed in the temperature of the sea at St. James in False Bay, at or near this time in observations taken three times a day.

In attempting to co-ordinate these various observations and to discover some cause or causes of such occurrences many difficulties arise. Some narratives are set down from memory several years after the event, and many may be influenced by preconceived ideas as to the causes of the phenomena. On the whole, however, they are so circumstantial, and deal with such well-marked incidents, that they themselves are well worthy of permanent record, and, maybe, are of more value in this enquiry than any deductions which may at this stage be drawn from them. They point to certain biological and physical characteristics of the South African seas which require further investigation on account of their practical as well as their purely scientific importance.

We may in the first place eliminate most of the alleged causes of the diminutions of the fish supply mentioned in the previous sections (1-13) as insufficient at least to account for any such sudden and wholesale destruction of marine life as is described in the preceding instances.

We may further narrow the enquiry by considering first those cases in which "red water" appears. This phenomenon is of such a striking nature that it can scarcely fail to be observed. The most definite instance of this is that occurring

in Saldanha Bay about the year 1907 and near Stumpnose Bay about 1869. To this category may also be added the case of the "phosphorus" in Table Bay about 1888. In the occurrence at Swakopmund in 1880 the peculiar red ("blütig") colour of the sea would seem to indicate that there was at least some element of this nature present here, though it is to be noted that the colour of the water was described by another observer some months after the occurrence as "inky." This, together with the fact that at the somewhat similar occurrence in the neighbourhood (Walfish Bay) there is no mention of red water, seems to indicate that, if present, it was not the main factor in the disturbance at Swakopmund.

There seems, however, to be no doubt that in some instance decaying masses of *Noctiluca* ("red water") is the *immediate* cause of the death of fish by suffocation, though there remains to be accounted for the cause of the accumulation and dying-off of these animals.

The second apparent cause of such phenomena is the presence of vegetable matter (diatoms) in masses, leading to decomposition and consequent suffocation of sea animals. This appears to have happened in the occurrence at Schell Bay.

The main factor in the occurrences at Walfish Bay also seems to have been the decay of diatomaceous matter in the bottom of the bay in enormous quantities, a sample of the mud at the bottom of the bay having been found on microscopic examination to consist almost exclusively of diatoms.

The occurrence at Knysna will not, however, admit of any such explanations. There is no record of the presence of *Noctiluca* in large quantities either in the sea or the lagoon. Here their absence in quantity may be accounted for by the fact that there is here no chance of the water remaining in an undisturbed state, as the currents in the sea are strong and the entrance to the lagoon is very narrow. Special enquiries were made as to whether "red water" was ever found in the lagoon, and it appears to be unknown.

The explanation generally accepted at Knysna is that the death of fish is due to cold water, as it is always associated with the presence of such water. The occurrence is annual, and in a more or less marked degree, so that it may be accepted as a statement of fact that the fish die off when the cold water appears—whether from the actual cold or not is a different question. Further, it is observed on such occasions that the cold water is of a distinctly different colour from that of th normal sea water, so marked that ordinary fishermen recognis it readily and expect to find dying or dead fish in it. The fishermen describe the cold water as of a muddy colour.*and

* It is not associated with heavy rainfalls which often produce large areas of muddy water in the sea.

the normal sea water blue, and that is an accurate enough description for recognition purposes. The actual colour of the cold water is a pale muddy or sandy colour with a tinge of green, though, when dipped up in a vessel, it is seen to be much more transparent than the blue water. The muddy and blue water, described by Mr. M'Lachlan at Stumpnose Bay, on the west coast, agrees with the condition at Knysna, and here also dead fish (Sardines) " in tons " were found in the muddy water. It is not mentioned, however, that the muddy water was particularly cold, and the presence of hundreds of dead sea Duikers is a puzzling element. It cannot be readily supposed that these birds died of cold, nor can it be imagined that they died of hunger in the presence of so many dead fish. The only explanation that would seem to fit in with the other factors, is that they died in some way from eating the dead fish, for which however there is no evidence.

Other cases in which the coldness of the water seems to have played a part are those near East London, 26th September, 1903, and at Mossel Bay at about the same time (shortly before the 20th). In the former the temperature of the water as observed at East London fell somewhat abruptly from 62° F. on the 7th to 50° F. on the 10th (the minimum for the year), and thereafter gradually became normal. The actual temperatures from the 7th to the 12th were 62°, 57°, 56°, 50°, 51°, 56°. On the other hand, we have the evidence of the trawler that, on the 8th to the 11th, while trawling 18 miles east of East London, the water was so warm that it attracted special attention. This would, of course, be at some distance from the shore, so that, while the cold water was inshore, the water further to sea was warm. The presence of warm water in the pools at Keiskama may have been due to the shallowness of the water and its heating up after the occurrence. Temperatures were also observed at Port St. John's further to the North, and these showed a variation of 1° only during the same period, so that the cold water was rather local. In the occurrence at Mossel Bay the presence of a " cold mist enveloping the Bay " was adduced as evidence of the existence of cold water, " perhaps due to an iceberg." Icebergs are not known to navigators to occur within such a distance of the South African shore as would have this effect.

In the Table Bay case (1837) and Cape Receife (1886) there is no mention of cold water, nor of any peculiarity in the colour of the water.

The coastline affected is of particular interest. Such occurrences do not seem to be known in Natal, and are confined, so far as records go, to the coast extending from East

London on the east coast round the south coast to Walfish Bay (or Swakopmund) on the west coast.

It is of special interest also to note that, while at all other places the occurrence seems to be more or less intermittent, at Knysna and at Walfish Bay it is well recognised as an annual one. At both of these places it occurs also at a definite time of the year—the mid and late summer months.

It is just on this coast that the cold Antarctic current going from west to east strikes the continent of Africa, and meets the warm Mozambique current coming southwards along the east coast, and it may be supposed that Knysna is a point at which forms of animal life, accustomed more or less to warmer water than is found further west, would suffer more from the inset of the cold water. (Compare the effects of cold on the Frost-fish, p. 125.)

The dying off of the fish at Walfish Bay seems more attributable to the pollution of the water by decaying vegetable matter accumulating in the bay from the sea. The dying off of the diatoms may be due to the change of temperature which the west coast division of the Antarctic current undergoes here, just as the south coast division of the current does at Knysna It may be of significance that Soles are frequently cast up at Walfish Bay, but not at Knysna. They were notably absent from the other occurrences.

It is to be noted also that it is mainly the waters of the immediate coast that are affected, pointing to an upswelling of cold waters (Antarctic current?) from under the warmer waters (Mozambique stream ?).

These physical features are reflected in the forms of animal life in the sea, the fauna of the east coast being markedly different from that of the west. The Snoek, for instance, is a characteristic west coast form, and occurs, at certain seasons, in great abundance from Cape Point northwards. It is found occasionally at Mossel Bay and Plettenberg Bay, but very rarely at Port Elizabeth, and has not been recorded from the east coast north of that town. It is a fish of the high seas and only at times comes close inshore. It has never been mentioned as among the fish affected in the above cases, but it may be accepted as established that its occurrence is largely influenced directly or indirectly by the temperature of the water. It is essentially a migratory fish, and doubtless its abundance or scarcity on the coast of South Africa is dependent to some extent at least on the temperature condition of the sea at the season in which it approaches the shore. (*Vide* p. 116).

The Red Stumpnose (*Chrysophrys gibbiceps*) may be taken as a typical example of a warm-water fish. It extends from the east coast along the south coast as far as False Bay. It is

seldom found in Table Bay or to the north of Table Bay. Unlike the Snoek, it is a shore-frequenting form, and it is of significance that at Knysna, when cases of mortality among fish occur, it is the species most seriously affected.

These two cases illustrate the influence of the cold stream in its extent along the coast. Other cases illustrate the upswelling of the cold water on the shores from under the warm water, as it is the shore forms which are mostly affected.

There seems little doubt, therefore, not only that the present distribution of fish and marine fauna generally on the South African Coast is determined by the cold Antarctic water meeting the warm Agulhas current, but that the relative abundance at different times may be due to the relative strength of the opposing currents, the effect of the cold current being in severe cases an extensive mortality in marine life, the extension of the cold water for instance to the east, permitting the presence of Snoek as far east as Port Elizabeth, and the extension of the warm water permitting the presence of the Red Stumpnose towards the west even occasionally to Table Bay. If a pelagic rather than a rock-frequenting fish be desired as an example comparable with the Snoek, *Elops saurus* (the " springer " of Natal and " Cape Salmon " of Port Elizabeth) may be cited, as it is common on the east coast and only occasionally found as far west as Knysna. The " Seventy-four " (*Dentex undulatus*) is another example of a warm water fish.

The cause of the warm Mozambique current on the east coast, and its continuation as the Agulhas current on the south coast, is the trade winds of the Indian ocean, which drive the water from a south-easterly direction towards the Equator, where it becomes heated up, and, as the Equatorial current, impinges on the African continent, and is diverted along its eastern shore. It is, therefore, on the east coast of South Africa, turned southwards and encounters the south-east trade winds in the modified form of the Cape south-easters. These have a tendency to drive it back, or, at least, keep it in check, so that the Antarctic current will extend further to the east. It seems to be due to this that we have the apparently anomalous fact that an on-shore wind (S.E.) is followed by the appearance of cold water.

There are, however, many obscure points regarding the currents of the South African coast, which can only be cleared up by a series of systematic observations. A good deal might be done by observation of surface temperatures at stations on the coast line, but it is essential that observations of tem-

perature, salinity, etc., be taken at various depths at sea in order to throw further light on the question.

It need hardly be pointed out that the fuller information and investigation of the various factors which influence the fish supply are of urgent necessity from a purely practical point of view. Even should it prove that some or all of these are beyond control, to which indeed some of the evidence seems to point, yet their elucidation will be of the utmost importance, if only to prevent legislation in futile or injurious directions, and may prove of a more direct use in indicating in what regions fish may or may not be expected to be found. Thus, to take a concrete example, strong and continued south-east winds may be found to be associated with the presence of the colder waters and their characteristic fish, such as the Snoek. On the other hand, in the absence of such winds, the fish characteristic of warmer waters may more profitably be looked for.

The proper control of injurious methods of fishing if proved to be injurious, the imposition of close seasons, size limits, or even protection in certain areas are therefore obviously bound up with an accurate knowledge of the physical conditions of life in the sea.

Finally, it must be recognised also that whatever the cause may be, the history of nearly all fisheries is that the fishermen have to resort to more effective methods of fishing, and that the small open boats at first in use become no longer adequate to meet requirements. Fishermen are often of a conservative disposition, and as often are unable to provide the means for such improvements. In many countries the State has come to their assistance, and by a system of judicious loans has considerably advanced the industry. The South African native fishermen are, in these respects, no exception to fishermen in general, and some such system may also prove of great advantage in the development of this section of the industry in this country. The improved harbour accommodation about to be provided by Government at Table Bay and Kalk Bay will render it possible for the fishermen to use larger and better equipped boats, in place of the small open boats, which have to be carried ashore out of reach of the sea on their return from fishing operations. The present time, therefore, is suitable for the initiation of some such system. The greatest advance in the industry is of course to be looked for from independent companies, such as the trawling companies, in no need of such assistance, but there will always remain plenty of scope for the native fishermen, whose field of operation lies closer inshore.

[C.P. 6—'14.]

III.—THE CAPE CRAWFISH AND CRAWFISH INDUSTRY (*continued*).

Since the last account of this subject (Marine Biological Report No. 1), the Fishery Board, at the request of the Administrator, have taken the matter up and have examined a number of witnesses representing both the interests of the canners and of the native fishermen. In the course of the enquiry, additional information has been obtained, some of which it is desirable to put on record. All the evidence pointed to the immediate necessity of adequate legislative measures for the safeguarding of the industry, and the size limit is now raised from three to four inches, four months' close season is imposed, and females in berry are protected—the only exception to the size limit being a concession to the native fishermen in the case of crawfish taken solely for the purposes of bait. It became apparent during the course of the enquiry that a good deal of information was still desirable with regard to the times of spawning, the possible migration of the fish from one part of the coast to another, the alleged difference in the spawning season at different parts of the coast, the size at which crawfish become mature, at what times and in what places the males and females were to be found, etc.

The experimental hauls of crawfish have been continued, and we have now a record of such hauls for a complete year, made in Table Bay off the Woodstock Beach. These additional observations are given here, and a summary for the whole year prepared, so that it is seen at a glance how the crawfish vary in number and kind (young or old, male or female) at this locality. They throw some light on the above questions.

A series of tow-nettings has also been completed for the year, and the larvæ (*Phyllosomas*) of the crawfish have been noted in each.

A later stage, the "puerulus" or "natant" stage of the crawfish, has been found and some preliminary notes on this are added.

The experimental rearing of crawfish has been continued at the Marine Station at St. James. In this connection, it is of interest to learn that the Japanese, who have a valuable crawfish industry of their own, have for some time been experimenting in the same direction.

The following notes may therefore be arranged under the headings :—

1. Information from canners and fishermen.
2. Experimental hauls of Crawfish.
3. Tow-nettings and larvæ of Crawfish.
4. The "puerulus," or natant stage of the Crawfish.

1. Information on Crawfish obtained from Canning Companies and Fishermen.

Representatives of the following canning companies gave evidence at the enquiry held by the Fishery Board. Native and Italian fishermen were also represented.

(*a*) Saldanha and St. Helena Bay (Stephan Bros.).
(*b*) Hoetjes Bay and Steenbergs Cove (Hinchliffe and Holland).
(*c*) Hout Bay (Plessis).
(*d*) Cape Town Canning Co. (Van Zweiberg).
(*e*) Scotia Works, Woodstock (Ovenstone).
(*f*) Woodstock (Hickson and Sons).
(*g*) Saldanha Bay Company (Schermberg).
(*h*) Native fishermen.
(*i*) Italian fishermen.

(*a*) At Saldanha Bay and St. Helena Bay no diminution in the supply is noted, except near the coast. There are two seasons for Crawfish—October to November, when large males are caught, and April to June, when mostly females are caught. A female of $3\frac{1}{2}$ inches has spawned once at least. Males cast shell from about December 15th to March 1st, and will not take bait then. They hide in their holes, so that their enemies cannot get them. The female fish lie in the shallows until their eggs are nearly mature, when the males come inshore and "milk" the eggs and then go back again (this appears to be incorrect). The females, when depositing their eggs, lie among the rocks at low water. They have been caught 40 or 50 yards from the shore. When the females are spawning, the boats do not go after them, but have to go into deeper water for their catches. They very rarely catch a female (compare the statements of Table Bay fishermen on this point.) With regard to evidence of migration, about the beginning of October, 1912, the boats had to go to a place right south to the other side of North Bay, and by the middle of October the boats had got to the middle of North Bay (showing a movement northwards in October).

(*b*) In Steenbergs Cove and district north of Jacobs Rock about 90 per cent. of the fish are females, from the middle of December to the first week of February, and 99 per cent. of these are in berry (compare experimental hauls at Table Bay). From about the middle of February to early in July about 80 per cent. are mature males, the rest being small males of 3 to 4 inches. The mature males are more than 4 inches. From the middle of July to early in September, females and small males are found. This appears to be the season when females and the small fish are casting their shell, large quantities of empty shells being cast up on the beach there. From the middle of September to early in December, the fish are all large males. Thus in one week, of 192,000 fish, 90 per cent. were more than 5 inches in length. They may grow to 8 inches. This is the best season north of Jacobs Rock. In December, as the males cast their shell, they go off into deeper water, and return in February. In tabular form, these facts may be stated as follows :—

Middle of December to early in February.	Females, 99 per cent. in berry. (Males casting shell in deeper water.)
Middle of February to early in July.	Males, 80 per cent. mature (over 4 inches).
Middle of July to early in September.	Females and small males (casting shell).
Middle of September to early in December.	Males, 90 per cent. over 5 inches.

Over two million fish were used in two factories last year. If the size limit proposed, of $4\frac{1}{2}$ inches, is imposed, no females at all would be caught. In deeper water you get only large fish, in shallow water you are more likely to get small fish. At St. Martin's Point, fish measuring 8 inches are got, not five per cent. being less than 5 inches.

(*c*) Four inches would protect females, at $3\frac{1}{2}$ inches you protect females without eggs. " Your close season protects the Crawfish. If you come with the best bait they will not bite. We believe the close seasons, as now arranged, are very good indeed. The fish protect themselves." Hout Bay is at least one month in advance of Cape Town. Crawfish are not on a limited bank ; there are pockets of them. When the north-west wind blew at an unusual time, you would see the beach at Mouille Point covered with crawfish knocked against the rocks, because they are sick and are changing their shell. When the south-easters blow, they take shelter round Robben Island. The fish have not become scarcer. Formerly they fished with

two men in a boat, and had seven nets. To-day they go out with a motor-boat, and when fish are biting well, 6,000 crawfish can be caught in three or four hours. This has been experienced in Table Bay, Robben Island and Kommetje. They do not fish between Mouille Point and Oude Kraal. Perhaps the sewer has something to do with the disappearance of fish there.

(*d*) There is no objection to a close season in May and June ; the fish are scarce. There are other fishing grounds that have not been touched in deeper water. The males are in deeper water at this time, in about 20 to 25 fathoms, nearer Dassen Island. In the beginning of October, males come into shallow water. Crawfish are found in False Bay, but one does not know where the bank is.

(*e*) There seems to be no diminution in the supply. In 1910 two boats landed 83,300 or 41,650 per boat. In 1911 four boats landed 580,000, or 145,000 per boat. In 1912 seven boats landed 1,247,400, or 178,200 per boat. In 1913 nine boats landed 1,834,760, or 203,862 per boat. This last was for one month less in the year. From May 20th to about June 15th, there are a great many small or female fish, and this should be a close season. The total catch of Crawfish in the Colony is about 12 million for the season. Between May 15th and June 15th, when the small fish are caught, ought to be a close season. Good fish could be caught further out in deeper water, say, of 20 fathoms, but fishing here is difficult if there is any current.

(*f*) Crawfish seem to have diminished in size in recent years. It is seldom that very large crawfish are now caught unless we go further afield. Robben Island is the breeding ground for small fish. In the month of May I calculate that 1,600,000 small fish are caught. Fishing in Table Bay is not so good as it was.

Mr. Hickson furnished the following abstract from his diary :—

February.—Fish from Hout Bay on 17th February : 6 rotten and diseased fish ; some small fish with inside roe. Yellow fish and no class.

March.—Large male fish ; on 31st March noticed small fish and 5 per cent. females.

April.—Some days very large fish, and others mixed lots · about 5 per cent. females.

May 1st to 5th.—Very large fish ; males.

May 6th.—Medium ; females.

May 14th to 31st.—Small fish ; females predominate.

June 23rd.—Fairly large fish ; females less.

June 25th.—Large fish.

June 26th.—Good size fish.

July.—Mixed lot ; mediums ; male and female.

August 14th.—95 per cent. large male fish noted ; female very little berry or roe ; noticed it was diminishing in fish.

August 15th.—97 per cent. males, large and small, noticed roe in fish nearly exhausted.

August 18th to end of month.—All male fish ; large and small.

September 8th.—All male fish and rather small size. The small males a better red than usual.

September 26th.—Inspected boats unloading. About 30 females with outside berry thrown into sea ; the rest males

October.—All males ; large size.

October 26th.—Fish not up to mark unless caught outside Robben Island.

(*g*) In 1910 we made 850 cases ; in 1911, 1,750 cases ; in 1912, 2,300 cases ; and 1913, 3,200 cases, there being from 105 to 110 Crawfish in each case. No Crawfish are caught at Saldanha Bay between the middle of May and the end of August owing to rough weather.

(*h*) Crawfish were a hundred times more plentiful formerly than at the present time. There are now practically no Crawfish in Table Bay. About 25 years ago they were very plentiful. They are now further away. In early days you could catch Crawfish by simply wading into the water near the present explosives jetty, or at the sewage pipes in Table Bay.

At certain seasons the only bait that can be got for Hottentot fish or Maasbankers is Crawfish in berry. At this time the male Crawfish are sick and cannot be caught, as they will not take the bait. It is necessary to get Maasbankers, as this is used for bait for the larger fish, such as Stockfish. The only place where you can catch Crawfish now (November, 1913) is at the sewer (off Woodstock Beach). At Camps Bay and all round, there are no Crawfish, nor at Robben Island. All these are females in berry. Only five or six hundred Crawfish are used per day by fishermen, while the Italians catch three or four thousand per boat in the season.

(*i*) Italian fishermen state that in May over 90 per cent. of fish caught are very small females, and suggest a close season of four or five weeks at this time, say, from 15th May to 15th June. Very few males are caught during that period ; they are believed to have gone into deeper water. The females are full of eggs inside. After June there are not such quantities of females. In July we catch more males and less females.

In August we catch very few females. Females are in berry from 2 to 4½ inches. Females 4½ inches are seldom seen. The majority of fish we catch are between 3½ and 5 inches, and from 5 to 7 inches 15 per cent. Males and females are about the same in quantity. If we start fishing in March at Green Point we catch mostly males ; later on, males and females. The smallest Crawfish we have seen is 1½ inches. The smaller we never see ; they run away and stay in their nests. There has been no diminution in the supply, but more boats are now engaged—10 more than last year. We used to catch a good deal of fish behind the Breakwater. We have not tried fishing there for a long time. At Robben Island we fish in about 10 fathoms of water. In the middle of Table Bay we get none. We do not know where the males go when females are so abundant, perhaps to Melk Bosch. About five per cent. only of the fish caught about February 15th are soft.

2. Experimental Hauls of Crawfish in and around Table Bay (*continued*).

The following is a continuation of the records of Crawfish caught in the series of experimental hauls begun in November, 1912, and published in the Marine Biological Report, No. 1, p. 7 :—

No. 23.

Date : 2/5/13. Number of hauls : 14.
Locality : Opposite the Milnerton Hotel, a mile off shore.
Condition of sea : Calm and smooth ; slight westerly swell.
Depth : 8 fathoms. Temperature : 58° F.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	..	..	..	..
Hard new shell	..	..	..	..	1	4	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total of males : 5. Average number per haul : 0·367.
Average size : 5.8.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +.
Hard old shell	..	..	..	2	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total of females : 2. Average number per haul : 0 ·142.
Average size : 4.
Total number of males and females : 8.
Average size : 5 ·25. Average number per haul : 0 ·507.

No. 24.

Date : 9/5/13. Number of hauls : 14.
Locality : Near Milnerton Beach, ½ mile off shore.
Condition of sea : Calm and smooth.
Depth : 7 fathoms. Temperature : 60°.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell ..	..	8	2	4	3	10	2
Hard new shell ..	..	..	..	..	..	..	..
Soft old shell ..	..	..	..	..	..	..	..
Soft new shell ..	..	..	..	..	..	..	..

Total of males : 29. Average number per haul : 2 ·071.
Average size : 4 ·378.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +,
Hard old shell ..	..	..	..	4	2	..	..
Hard new shell ..	..	..	..	..	..	..	..
Soft old shell ..	..	..	..	..	..	..	..
Soft new shell ..	..	..	..	..	..	..	..
In berry ..	..	..	..	..	..	..	..
In eyed berry ..	..	..	..	..	..	..	..

Total of females : 6. Average number per haul : 0 ·428.
Average size : 4 ·333.
Total number of males and females : 35.
Average size : 4 ·371. Average number per haul : 2 ·5.

No. 25.

Date : 20/5/13. Number of hauls : 14.
Locality : Near Milnerton Beach, about ½ mile off shore.
Condition of sea : Calm.
Depth : 7 fathoms. Temperature : 58°.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell ..	..	9	..	..	2	6	1
Hard new shell ..	..	..	..	..	..	..	..
Soft old shell ..	..	..	..	..	..	..	..
Soft new shell ..	..	..	..	..	..	..	..

Total of males : 18. Average number per haul : 285.
Average size : 5 ·464.

Female Crawfish.

Size in inches	1 +,	2 +	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	11	..	1	2	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total of females: 14. Average number per haul: 1.
Average size: 3·83.
Total of males and females: 32. Average size: 5·343.
Average number per haul: 2·285.

No. 26.

Date: 30/5/13. Number of hauls: 14.
Locality: Near Milnerton, about ½ mile off shore.
Conditions of sea: Choppy from S.E.
Depth: 7 fathoms. Temperature: 57°. Condition of bottom: Rocky.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	1	6	22	10
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total of males: 39. Average number per haul: 2·785.
Average size: 6·326.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	..	8	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	.	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total of females: 8. Average number per haul: 0·571.
Average size: 5·093.
Total number of males and females: 47.
Average size: 6·117.
Average number per haul: 3.35.

No. 27.

Date : 12/6/13.
Number of hauls : 14.
Locality : Opposite the mouth of the sewer near Woodstock Beach.
Condition of sea : Very rough and choppy.
Depth : 3 fathoms. Temperature : 55°.
Condition of bottom : Sandy and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	39	17	1	1	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total of males : 58. Average number per haul : 4·142.
Average size : 1·232.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	..	..	..	..
Hard new shell	24	15	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total of females : 39. Average number per haul : 2·785.
Average size : 1·795.
Total number of males and females : 97. Average size : 1.458

N.B.—The small crawfish in sizes shown above swarm around the mouth of the sewer in thousands, and it was only on account of the large meshes of the nets used that at least twenty times more were not caught.

No. 28.

Date : 26/6/13. Number of hauls : 14.
Locality : Near Milnerton Beach, about ½ mile off shore.
Condition of sea : Very smooth and calm.
Depth : 7 fathoms. Temperature : 56°.
Bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	1	8	22	44	17
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 92. Average number per haul : 6 ·571.
Average size : 6 ·005.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	1	13	9	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total of females : 23. Average number per haul : 1 ·642.
Average size : 4 ·608.
Total of males and females : 115. Average size : 5 ·726.
Average number per haul : 8 ·214.

No. 29.

Date : 4/7/13. Number of hauls : 14.
Locality : Opposite Milnerton Hotel, ½ mile off the shore.
Condition of sea : Calm.
Depth : 7 fathoms. Temperature : 56°.
Condition of bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	1	9	21	24	6
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 61. Average number per haul : 4.357.
Average size : 5 ·790.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	39	5	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 44. Average number per haul : 3 ·143.
Average size : 4 ·5.
Total number of males and females : 105. Average size : 5 ·25. Average number per haul : 7 ·5.
[C.P. 6—'14.]

No. 30.

Date: 8/7/13. Number of hauls: 14.
Locality: Opposite Milnerton Hotel, ½ mile off shore.
Condition of sea: Smooth, with heavy swell.
Temperature: 56°.
Condition of bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	1	1	7	20	29	3
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 61. Average number per haul: 4·357.
Average size: 5·737.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	4	19	9	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	1	3	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 36. Average number per haul: 2·571.
Average size: 4·583.
Total number of males and females: 97. Average size: 5·309.
Average number per haul: 6·928.

No. 31.

Date: 15/7/13. Number of hauls: 14.
Locality: Milnerton Beach, opposite Milnerton Hotel, ½ mile from the shore.
Condition of sea: Westerly swell.
Depth: 12 fathoms. Temperature: 52°.
Condition of bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	1	4	14	5
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 24. Average number per haul: 1·714.
Average size: 6·229.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	4	1	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry ..	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 5. Average number per haul: 0·357.
Average size: 4·6.
Total number of males and females: 29. Average size: 5·949.
Average number per haul: 2·071.

No. 32.

Date: 18/7/13. Number of hauls: 14.
Locality: Off Milnerton Beach opposite the hotel, about ½ mile from the shore.
Condition of sea: East wind; slight westerly swell.
Depth: 12 fathom. Temperature: 53°.

Male Crawfish. :

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	5	11	13	18
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 47. Average number per haul: 3·357.
Average size: 6·244.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	10	68	12	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry ..	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 90. Average number per haul : 6·429.

Average size : 5·311.

Total number of males and females : 137.

Average size : 5·631.

Average number per haul : 9·785.

No. 33.

Date : 25/7/13. Number of hauls : 14.

Locality: Off Milnerton Beach, about ⅓ mile off the shore, opposite the Milnerton Hotel.

Condition of sea : Calm. Slight north breeze.

Depth : 11 fathoms. Temperature : 53°.

Bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +,
Hard old shell	..	..	..	4	16	54	77	10
Hard new shell	..	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..	..

Total number of males : 161. Average number per haul : 11·5.

Average size : 6·894.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	14	95	41	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 150. Average number per haul : 10·713.

Average size : 5·534.

Total number of males and females : 311.

Average size : 6·238.

Average number per haul : 22·214.

No. 34.

Date : 29/7/13. Number of hauls : 14.

Locality : Opposite Somerset Hospital, about 250 yards off shore.

Condition of sea : Choppy ; westerly swell ; S.E. wind ; rain.

Depth : 5 fathoms. Temperature : 55°.
Bottom : Rocky.
Males : Nil. *Females :* Nil.

No. 35.

Date : 31/7/13. Number of hauls : 14.
Locality : Milnerton Beach, opposite the hotel, about ⅓ mile off shore.
Condition of sea : Calm, slight E. wind.
Depth : 11 fathoms. Temperature : 59°.
Bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +,	8 +
Hard old shell	..	..	1	6	11	28	18	2
Hard new shell	..	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..	..

Total number of males : 66. Average number per haul : 4·714.
Average size : 6·378.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	2	27	115	27	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	1	3	2	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 177. Average number per haul : 12·642.
Average size : 5·395.
Total number of males and females : 243. Average number per haul : 17·357.
Average size : 5·886.

No. 36.

Date : 5/8/13. Number of hauls : 14.
Locality : Off Woodstock pipe.
Condition of sea. : Calm N. breeze.
Depth : 3 fathoms. Temperature : 53°.
Bottom : Sand, stones, and weed-grown.
[C.P. 6—'14.]

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	..	1	2	3
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 6. Average number per haul: 0·429.

Average size: 5·916.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	1	2	4	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 7. Average number per haul: 0·5.

Average size: 4·892.

Total number of males and females: 13. Average size: 5·365.

Average number per haul: 0·925.

N.B.—About 575 crawfish, ranging in size from 1 inch to $2\frac{3}{4}$ inches were also caught. The fishermen remarked on the splendid condition of the large crawfish.

No. 37.

Date: 14/8/13. Number of hauls: 14.

Locality: Milnerton Beach, opposite the hotel, about $\frac{3}{5}$ mile off the shore.

Condition of sea: Slightly choppy, E. wind; very muddy.

Depth: 12 fathoms. Temperature: 53°.

Bottom: Rocky.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	5	19	40	10
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 74. Average number per haul: 5·285.

Average size: 6·057.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old Shell	..	..	..	1	1	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 2. Average number per haul : 0 ·142.

Average size : 4 ·75.

Total number of males and females : 76. Average number per haul : 5 ·428. Average size : 6 ·023.

N.B.—Fishermen say that the females are now sick, and are in hiding.

No. 38.

Date : 16/8/13. Number of hauls : 14.

Locality : Milnerton Beach, opposite the hotel, about ½ mile off shore.

Condition of sea : Calm, very slight swell ; slightly muddy.

Depth : 10 fathoms. Temperature : 54°.

Bottom : Rocky.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	..	5	2	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 7. Average number per haul : 0 ·5.

Average size : 5 ·543.

Female Crawfish : Nil.

No. 39.

Date : 19/8/13. Number of hauls : 14.

Locality : Mouille Point Light House, about ¼ mile off shore.

Condition of sea at first : Calm, with slight swell; then choppy, with N.E. wind.

Temperature : 54°. Bottom : Rocky bamboos.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	18	5	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 23. Average number per haul: 1·642.

Average size: 2·467.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	14	2	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 16. Average number per haul: 1·142.

Average size: 2.5.

Total number of males and females: 39. Average size: 2·483.

Average number per haul: 2·785.

N.B.—A good many crawfish below the sizes indicated escaped through the meshes of the nets.

No. 40.

Date: 23/8/13. Number of hauls: 14.

Locality: Opposite the Milnerton Hotel, about ½ mile from the shore.

Condition of sea: Very rough; E. wind; heavy swell.

Temperature: 54°. Bottom: Rocky and weed-grown.

Male Crawfish: Nil.

Female Crawfish: Nil.

No. 41.

Date: 26/8/13. Number of hauls: 14.

Locality: Opposite Milnerton Hotel, about ½ mile off shore.

Bottom: Rocky and weed-grown.

Condition of sea: At first calm; then choppy with N.N.E. wind. Temperature: 53°.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	2	2	12	31	36	8
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 91. Average number per haul: 6·5.

Average size: 5·714.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	..	..	1	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 1. Average number per haul: 0·339.

Average size: 4·75.

Total number of males and females: 92. Average size: 5·703.

Average number per haul: 6·571.

In catches of crawfish made by local fishermen and estimated by them to be above 4,000, were only 20 to 30 females, some of them in berry.

No. 42.

Date: 5/9/13. Number of hauls: 8.

Locality: Milnerton, opposite the hotel, about ⅓ mile off shore.

Condition of sea: At first calm, with slight E. wind; then heavy rain and strong S.E. wind.

Depth: 7 fathoms. Temperature: 53°.

Condition of bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	19	1	5	1	3	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 29. Average number per haul: 3·625.

Average size: 3·232.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	6	1	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 7. Average number per haul: 0·875.

Average size: 2·607.

Total number of males and females: 36. Average size: 3·111.

Average number per haul: 4·5.

Local fishermen bring in great catches of male crawfish; the females are very scarce, and some of those that are caught are in berry.

No. 43.

Date: 9/9/13. Number of hauls: 14.

Locality: Opposite Milnerton Hotel, about ⅓ mile off shore.

Condition of sea: Choppy; slight swell; N.E. wind.

Depth: about 5 fathoms. Temperature: 53°.

Bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	3	..	..	..	..	1
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 4. Average number per haul: 0.285.

Average size: 3·375.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	1	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 1. Average number per haul: 0·071.

Average size: 2·5.

Total number of males and females: 5. Average size: 0·357.

Average number per haul: 3.2.

N.B.—Fishermen say that fish are "travelling."

No. 44.

Date: 13/9/13. Number of hauls: 14.

Locality: Milnerton Beach, opposite the hotel, about ⅓ mile from the shore.

Condition of sea : Slightly choppy ; E. wind.
Depth : About 6 fathoms. Temperature : 54°.
Bottom : Rocky. and weed-grown.

Male Crawfish.

Size in inches	1 +	2 +	3 +	4 +	5 +	6 +	7 +
Hard old shell	1	54	12	10	12	14	2
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 105. Average number per haul : 7·5.
Average size : 3 ·545.

Female Crawfish.

Size in inches	1 +	2 +	3 +	4 +	5 +	6 +	7 +
Hard old shell	..	26	1	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 27. Average number per haul : 1 ·928.
Average size : 2 ·24.
Total number of males and females : 132. Average number per haul : 9 ·428.
Average size : 3 ·279.

No. 45.

Date : 23/9/13. Number of hauls : 14.
Locality : Milnerton Beach, opposite the hotel, about ½ mile from the shore.
Condition of sea : Calm, slight swell.
Depth : 7 fathoms. Temperature : 54°.
Bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +	2 +	3 +	4 +	5 +	6 +	7 +
Hard old shell	1	23	2	1	2	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 29. Average number per haul : 2 ·071.
Average size : 2 ·56.
[C.P. 6—'14.]

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	2	20	1	2	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	1	2	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 28. Average number per haul : 2. Average size : 2 ·589.

Total number of males and females : 57. Average size : 2.574.

Average number per haul : 4 ·07.

N.B.—A good many small crawfish escaped through the meshes of the net, and therefore could not be registered. The fisherman says that all big crawfish, especially females in berry, are to be found in Camps Bay.

No. 46.

Date : 26/9/13. Number of hauls : 14.

Locality : Milnerton Beach, opposite the hotel, ½ mile from the shore.

Condition of sea : Choppy ; slight north breeze ; misty.

Depth : 7 fathoms. Temperature : 54°.

Condition of bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	14	82	10	3	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 109. Average number per haul : 7 ·785.

Average size : 2 ·206.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	20	2	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry (soft old shell).	1	7	1	2	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 33. Average number per haul : 2 ·357.

Average size : 2 ·778.

Total number of males and females : 142. Average size : 2 ·269.

Average number per haul : 10 ·142.

N.B.—A good many small crawfish escaped through the meshes of the nets and, therefore, could not be registered or measured.

No. 47.

Date : 30/9/13. Number of hauls : 14.

Locality : Milnerton Beach, opposite the hotel, about ½ mile from the shore.

Condition of sea : Slight S.E. wind.

Depth : 6 fathoms. Temperature : 52°.

Condition of bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	17	18	1	..	1	1	1
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 39. Average number per haul : 2 ·785.

Average size : 2 ·521.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	14	21	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry (soft old shell).	..	..	4	12	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 51. Average number per haul : 3 ·642.

Average size : 2.26.

Total number of males and females : 90. Average size : 2.

Average number per haul : 6 ·427.

N.B.—A good many small crawfish must have escaped through the meshes of the nets and, therefore, could not be registered.

No. 48.

Date : 7/10/13. Number of hauls : 14.

Locality : Milnerton Beach, opposite the hotel, about ⅓ mile off shore.

Condition of sea : Choppy, S.E. wind.

Depth : 9 fathoms. Temperature : 53°.

Condition of bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +.	6 +,	7 +
Soft new shell	..	4	3	4	5	7	2
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 25 average number per haul : 1 ·785. Average size : 4 ·82.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	5	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry (soft old shell).	..	..	5	20	2	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 32. Average number per haul : 2 ·285.

Average size : 3 ·8.

Total number of males and females : 57. Average size : 6 ·004.

Average number per haul : 4 ·07.

No. 49.

Date : 13/10/13. Number of hauls : 14.

Locality : Milnerton Beach, opposite the hotel, about ½ mile off shore.

Condition of sea : Choppy ; very strong S.E. wind.

Depth : 8 fathoms. Temperature : 53°.

Condition of bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	2	62	1	4	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 69. Average number per haul: 4·928.

Average size: 2·717.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	21	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	5	9	1	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 36. Average number per haul: 2·571.

Average size: 3.

Total number of males and females: 105. Average size: 2·814.

Average number per haul: 7·5.

N.B.—Peter Sangiorgio, a fisherman, says that the females at Camps Bay are already losing the eggs, which are white and eyed.

A good many small crawfish escaped through the meshes of the nets.

No. 50.

Date: 18/10/13. Number of hauls: 14.

Locality: Milnerton Beach, opposite the hotel about $\frac{1}{3}$ mile from the shore.

Depth: 8 fathoms. Temperature: 52°.

Condition of bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	1	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 1. Average number per haul: 0·16.

Average size: 2·25.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	1	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	..	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 1. Average number per haul: 0·16.

Average size: 2·5.

Total number of males and females: 2. Average size: 2·375.

Average number per haul: 0·142.

N.B.—A few small crawfish must have escaped through the meshes of the nets.

No. 51.

Date: 21/10/13. Number of hauls: 14.

Locality: Milnerton Beach, opposite Milnerton Hotel, about ½ mile off the shore.

Condition of sea: Choppy; N.W. wind and slight swell

Depth: 8 fathoms. Temperature: 51°.

Condition of bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	20	..	1	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 21. Average number per haul: 1·5.

Average size: 2.238.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	1	20	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry	..	..	5	6	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females: 32. Average number per haul: 2·285.

Average size: 2·694.

Total number of males and females: 53. Average size: 2·514.

Average number per haul: 3.785.

N.B.—A few small crawfish escaped through the meshes of the nets and could, therefore, not be registered. The fishermen say that during the next week or so the male crawfish will begin to be sick. They point out that if an antennæ of a healthy crawfish is broken, the break is clean, right through the shell and the meat, whereas, with a crawfish that is beginning to be sick, the break is only through the shell, the meat inside being torn.

No. 52.

Date: 25/10/13. Number of hauls: 4.

Locality: Milnerton Beach, opposite the hotel, about ⅓ mile from shore.

Condition of sea: Rough; S.W. wind.

Depth: 8 fathoms. Temperature: 52°.

Condition of bottom: Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	1	1	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males: 2. Average number of haul: 0·5.

Average size: 2.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	1	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry (soft old shell).	..	1	2	..	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total of females: 4. Average number per haul: 1.

Average size: 3.041.

Total number of males and females: 6.

Average size: 3·041.

Average number per haul: 1.5.

N.B.—Some small crawfish escaped through the meshes of the nets and, therefore, could not be registered. Very pro-

bably, owing to the state of the weather and the roughness of the sea, the anchor rope broke and fishing operations had to be stopped before the full 14 hauls were made.

No. 53

Date : 28·10–13. Number of hauls : 14.

Locality : Milnerton Beach, opposite the hotel, about ⅓ mile from the shore.

Condition of sea : Smooth ; slight N.W. breeze.

Temperature : 53°.

Condition of bottom : Rocky and weed-grown.

Male Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	1	20	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..

Total number of males : 21. Average number per haul : 1.5.

Average size : 2·238.

Female Crawfish.

Size in inches	1 +,	2 +,	3 +,	4 +,	5 +,	6 +,	7 +
Hard old shell	..	15	..	..	..	..	..
Hard new shell	..	..	..	..	..	..	..
Soft old shell	..	..	..	..	..	..	..
Soft new shell	..	..	..	..	..	..	..
In berry (soft old shell).	..	..	4	4	..	..	..
In eyed berry	..	..	..	..	..	..	..

Total number of females : 23. Average number per haul : 1·642.

Average size : 2.717.

Total number of males and females : 44. Average size : 2·488.

Average number per haul : 3.142.

N B.—Some crawfish escaped through the meshes of the nets and, therefore, could not be registered. At Camps Bay the fishermen are now sometimes catching a few large (6 inches to 7 inches) male crawfish, which they describe as being in a new soft shell and as not suitable for sale. All the females caught this trip at Milnerton were in hard old shells, but some had a distinctly new shell forming under the old one.

No. 54.

Date : 1/11/13. Number of hauls : 14.
Locality : Milnerton Beach, opposite the hotel, about ½ mile from the shore.
Condition of sea : N.W. swell, choppy, N. breeze.
Depth : 9 fathoms. Temperature : 54°.
Condition of bottom : Rocky, weed-grown.

Male Crawfish. Nil.

Female Crawfish. Nil.

N.B.—The fishermen say that there will not be any crawfish at Milnerton Beach for some time to come.

These data are put in the form of the following table, from which some general conclusions bearing on practical questions may more readily be drawn :—

SYNOPSIS of Number and Description of Crawfish caught in Experimental

DATE.	MALES.						
	Hard Old Shell.	Hard New Shell.	Soft Old Shell.	Soft New Shell.	Total Number.	Average per Haul.	Average Size.
2 November, 1912 ..	273	..	1	16	290	12.08	5.65
6 „	19	..	..	42	61	2.54	2.7
12 „	11	..	..	..	11	2.75	1.18
13 „	6	..	..	3	9	0.56	5.33
28 „	18	..	..	..	18	2.25	1.39
5 December, 1912 ..	..	..	..	..	..	..	..
12 „	16	..	..	..	16	1.14	4.3
17 „	19	..	..	..	19	1.35	1.78
30 „	10	..	..	..	10	0.71	5.6
7 January, 1913 ..	9	7	..	..	16	1.14	4.31
10 „	18	..	..	6	24	1.71	4.45
14 „	..	..	..	..	..	..	..
21 „	..	..	..	..	..	..	..
28 „	2	..	..	..	2	0.14	6
4 February, 1913 ..	..	6	..	..	6	0.42	5.33
6 „	53	..	..	..	53	3.78	4.71
12 „	..	..	..	..	..	..	..
14 „	..	..	..	31	31	2.21	4.67
18 „	..	..	..	..	..	..	..
24 „	..	10	..	17	27	1.92	5.48
11 April, 1913	2	..	..	..	2	0.16	6
23 „	..	12	..	..	12	1	3.75
2 May, 1913	1	5	..	..	6	0.42	6
9 „	29	..	..	..	29	2.07	4.37
20 „	18	..	..	..	18	1.28	5.46
30 „	39	..	..	..	39	2.78	6.32
12 June, 1913	58	..	..	..	58	4.14	1.23
26 „	92	..	..	..	92	6.57	6
4 July, 1913	62	..	..	..	62	4.35	5.79
8 „	61	..	..	..	61	4.35	5.73
15 „	24	..	..	..	24	1.71	6.22
18 „	47	..	..	..	47	3.35	6.24
25 „	161	..	..	..	161	11.5	6.89
29 „	..	..	..	..	..	..	..
31 „	66	..	..	..	66	4.71	6.37
5 August, 1913 ..	6	..	..	..	6	0.42	5.91
14 „	74	..	..	..	74	5.28	6.05
16 „	7	..	..	..	7	0.5	5.64
19 „	23	..	..	..	23	1.64	2.46
23 „	..	..	..	..	..	..	..
26 „	91	..	..	..	91	6.5	5.71
5 September, 1913 ..	29	..	..	..	29	3.62	3.23
9 „ ..	4	..	..	..	4	0.28	3.37
13 „	105	..	..	..	105	7.5	3.54
23 „	29	..	..	..	29	2.07	2.56
26 „	109	..	..	..	109	7.78	2.2
30 „	39	..	..	..	39	2.78	2.52
7 October, 1913	25	..	..	..	25	1.78	4.85
13 „	62	..	..	..	69	4.92	2.71
18 „	1	..	..	..	1	0.16	2.25
21 „	21	..	..	..	21	1.5	2.23
25 „	2	..	..	..	2	0.5	2.
28 „	21	..	..	..	21	1.5	2.23
1 November, 1913 ..	..	..	..	..	..	..	..

Hauls in Table Bay from 2nd November, 1912, to 11th November, 1913.

Females.								Males & Females.		
Hard Old Shell.	Hard New Shell.	Soft Old Shell.	Soft New Shell.	In berry.	Total Number.	Average per Haul.	Average Size.	Total Number.	Average per Haul.	Average Size.
..	..	..	..	..	..	..	..	290	12.08	5.65
..	..	..	..	..	..	..	..	61	2.54	2.7
12	..	..	..	2	14	3.5	1.78	25	6.25	1.48
4	..	..	..	..	4	0.25	3.77	13	0.812	4.55
..	..	..	..	10	10	1.25	3.7	28	3.5	2.54
..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	5	9	0.64	2.55	25	1.78	3.64
16	..	..	..	6	22	1.57	2	41	2.92	1.89
..	..	..	..	1	1	.07	4	11	.78	4.8
..	..	..	..	21	21	1.5	3.1	37	2.46	3.7
..	..	..	..	3	3	0.21	3.33	27	3.89	1.92
..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	7	7	0.55	2.71	7	0.5	2.71
..	..	..	..	..	..	..	..	2	0.14	6
..	..	..	..	..	..	..	..	6	0.42	5.33
27	..	..	..	..	27	1.92	3.3	80	5	6
..	..	..	..	..	..	..	..	..	..	..
..	28	..	..	..	28	2	1.6	59	4.21	3.13
..	..	..	..	..	..	..	..	..	..	..
..	73	..	..	..	73	5.21	3.24	100	7.14	4.36
7	..	..	..	..	7	0.58	3.9	9	0.75	4.95
..	..	..	..	..	..	..	..	12	1	3.75
2	..	..	..	..	2	0.14	4	8	0.5	5.25
6	..	..	..	..	6	0.42	4.33	35	2.5	4.37
14	..	..	..	..	14	1	3.85	32	2.28	5.34
8	..	..	..	..	8	0.57	5.09	47	3.35	6.11
39	..	..	..	..	39	2.78	1.79	97	6.92	1.45
23	..	..	..	..	23	1.64	4.6	115	8.21	5.72
44	..	..	..	..	44	3.14	4.5	105	7.5	5.25
32	..	4	..	..	36	2.57	4.58	97	6.92	5.3
5	..	..	..	..	5	0.35	4.6	29	2.07	5.94
90	..	..	..	..	90	6.42	5.31	137	9.78	5.63
150	..	..	..	..	150	10.71	5.53	311	22.214	6.23
..	..	..	..	..	..	..	..	..	..	..
171	..	6	..	..	177	12.64	5.39	243	17.35	5.88
7	..	..	..	..	7	0.5	4.89	13	0.92	5.36
2	..	..	..	..	2	0.14	4.75	76	5.42	6.02
..	..	..	..	..	..	..	..	7	0.5	5.64
16	..	..	..	..	16	1.14	2.5	39	2.78	2.48
..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	1	0.33	4.75	92	6.57	5.7
7	..	..	..	..	7	0.87	2.6	36	4.5	3.11
1	..	..	..	..	1	0.07	2.5	5	3.2	0.35
27	..	..	..	..	27	1.92	2.24	132	9.42	3.27
25	..	..	..	3	28	2	2.58	57	4.07	2.57
22	..	..	..	11	33	2.35	2.77	142	10.14	2.26
35	..	..	..	16	52	3.71	2.16	91	6.5	2.57
5	..	..	..	27	32	2.28	3.8	52	4.07	6.004
21	..	..	..	15	36	2.57	3	105	7.5	2.81
1	..	..	..	..	1	0.16	2.5	2	2.37	0.142
21	..	..	..	32	11	2.28	2.69	53	3.78	2.51
1	..	..	..	3	4	1	3.04	6	1.5	3.04
15	..	..	..	8	23	1.64	2.71	44	3.14	3.48
..	..	..	..	..	..	..	..	..	..	..

From these observations the following general conclusions among others may be deduced.

Males are never entirely absent throughout the year and, contrary to what has been generally accepted, are fairly abundant in the months October to February. The months December to April are those in which they are fewest. There is a sudden increase in June, and a gradual falling off with fluctuations up to November. Males with soft new shell are found in November, December and January up to the 24th February, but only one (in November) with soft old shell, which is preparatory to moulting. Moulting is generally stated to take place in deep water, but it would appear from this that it also occurs, to some extent, in shallow water. Males in hard new shell, indicating a stage later than that of the soft new shell, were found in January, February, April and May. With regard to size there is an increase in larger forms in the winter months April-September.

The most striking feature in the variation in number of females is the sudden increase in June and July, and this is quite in keeping with the statement of fishermen that females are very abundant in this month. They reach their maximum in July, whereas the maximum number of males is in June. There is a decided falling off in August both in males and females. The largest females occur in May to August. The period at which mature males and females occur together is in June and July, and copulation probably takes place at this time. This is confirmed by the observation made on the crawfish kept at the Marine Laboratory at St James, when it was found that copulation followed shortly after moulting, and spawning occurred chiefly in these months. We may, therefore, be justified in concluding that in June and July males and females come together in the shallow water (about 6 fathoms) for reproduction.

The first females in berry were caught on the 23rd September, and they continued to be procured throughout the summer months till the 21st January.

3. In making the foregoing experimental haul, the opportunity was taken to carry out a series of townettings with a view to procuring further information as to the occurrence and habits of the young stages of the crawfish. These results, arranged in tabulated form, are as follows :—

Townettings in Table Bay from January, 1913, to June, 1914, showing the Occurrence of Larval Crawfish (*phyllosomas*).

Date.	Locality.	Depth.	Temperature.	Quantities in c.c.	Number of Phyllosomas.
10 Jan., 1913	Between Pier and Blaauwberg	..	58	11.6	
14 Jan., '13	Along the Blaauwberg shore towards Woodstock.	S	58	38.9	2
21 Jan., '13	Table Bay	S	58	12.4	9
,,	,, ...	..	..	36.4	20
,,	,, ...	..	..	69.1	3
27 Jan., '13	Between Milnerton shore and Woodstock sewer.	S	52	11.6	
,,	,, ,, ,, ,, ..	M	,,	19	1
4 Feb., '13	Near Milnerton	S	52	14.49	
12 Feb., '13	Near Milnerton and Woodstock beach ..	M	52	24.8	
18 Feb., '13	Near Milnerton beach	M	58	72.9	
,,	Across the Bay towards Milnerton ..	M	,,	69.6	
,,	,, ,, ,, ...	S	,,	25.6	
,,	From Milnerton towards Woodstock ..	M	,,	37.2	
11 Mar., '13	Across Table Bay	S	..	11.6	
,,	,, ...	S	..	9.1	
,,	,, ...	M	..	7.4	
2 May, '13	Near Milnerton	S	58	10.5	
,,	,, ...	M	..	16.5	
,,	,, ...	B	,,	9.1	
9 May, '13	Near Milnerton, along the shore	S	60	3.6	
,,	,, ,, ,, ...	M	,,	2.7	
,,	,, ,, ,, ...	B	,,	4.1	
20 May, '13	Near Milnerton	S	58	1.3	
,,	,, ...	M	,,	4.5	
,,	,, ...	B	,,	5.5	
30 May, '13	Near Milnerton, close inshore	M	57	51.3	
,,	,, ,, ,, ...	B	,,	65.4	
,,	½ mile off shore near Milnerton	S	,,	35.6	
20 June, '13	Near Milnerton	S	..	4.9	
,,	,, ...	M	,,	0.9	
,,	,, ...	B;	,,	1.7	
25 June, '13	Near Woodstock sewer	S	..	7	
26 June, '13	Near Milnerton beach	S	56	7.62	
,,	,, ...	M	,,	51.2	
,,	,, ...	B	,,	38.4	
4 July, '13	Between "America" wreck and Milnerton Hotel, ½ Mile off shore.	S	56	13.0	
,,	,, ,, ,, ,, ..	M	,,	7.1	
,,	,, ,, ,, ,, ..	B	,,	5.7	
10 July, '13	Near Woodstock sewer	..	..	0.3	
,,	,, ...	,,	,,	1.6	
,,	,, ...	,,	,,	1.6	
,,	,, ...	,,	,,	2.3	

(S, M and B indicate Surface, Mid-water and Bottom nets respectively. Temperatures are given in degrees Fahrenheit. The total quantity of plankton is given in cubic centimetres.)

Date.	Locality.	Depth.	Temperature.	Quantities in c.c.	Number of Phyllosomas.
15 July, '13	Off Milnerton beach, about 5 fur. from shore	S	52	11.2	
,,	,, ,, ,, ,, ..	M	,,	10.4	
,,	,, ,, ,, ,, ..	B	,,	4.0	
18 July, '13	Off Milnerton shore	B	53	24.8	
,,	Milnerton beach and Woodstock pipe ..	S	,,	7.4	
,,	,, ,, ,, ...	M	,,	23.2	
25 July, '13	Woodstock pipe	S	53	9.1	
,	.. ..	M	,,	9.1	
29 July, '13	Off the Breakwater	S	55	6.6	
,,	,, ...	M	,,	8.2	
,,	,, ...	B	,,	3.2	
31 July, '13	Milnerton beach	S	59	6.4	
,,	,, ...	M	,,	6.6	
,,	,, ...	B	..	24.8	
5 Aug., '13	Woodstock pipe	S	53	10.7	
,,	,, ...	M	,,	10.7	
,,	,, ...	B	,,	13.2	
13 Aug., '13	,, ...	..	..	..	
14 Aug., '13	Along the foreshore	S	53	14.0	
,,	,, ...	M	,,	18.2	
,,	,, ...	B	,,	43.0	
16 Aug., '13	Behind the Woodstock pipe	S	54	20.7	
,,	,, ,, ...	M	,,	19.0	
,,	,, ,, ...	B	,,	43.0	
19 Aug., '13	Mouille Point Lighthouse	S	54	15.3	
,,	,, ,, ...	M	,,	16.3	
,,	,, ,, ...	B	,,	14.0	4
23 Aug., '13	Woodstock pipe	..	..	9.1	
,,	Woodstock pipe & Mouille Point Lighthouse	S	54	39.2	
,,	,, ,, ,, ,, ..	M	,,	14 9	
,,	,, ,, ,, ,, ..	B	,,	47.2	
26 Aug., '13	Mouille Point Lighthouse & Robben Island	S	54	17.3	12
,,	,, ,, ,, ,, ..	M	,,	3.6	
,,	,, ,, ,, ,, ..	B	,,	10.0	8
5 Sept., '13	Mouille Point Lighthouse to Robben Island and back.	S	53	2.9	
,,	,, ,, ,, ,, ..	M	,,	27.6	
,,	,, ,, ,, ,, ..	B	,,	11.6	
,,	Somerset Hospital to Mouille Point Lighthouse.	S	,,	9.9	
,,	,, ,, ,, ,, ..	M	,,	45.2	
,,	,, ,, ,, ,, ..	B	,,	29.6	
9 Sept., '13	Woodstock pipe to the wreck of "America"	S	53	11.0	
,,	,, ,, ,, ,, ..	M	,,	2.9	
,,	,, ,, ,, ,, ..	B	,,	..	
,,	Mouille Point Lighthouse	S	,,	..	
,,	,, ,, ...	M	,,	16.0	
,,	,, ,, ...	B	,,	22.3	
13 Sept., '13	Round the two wrecks	S	54	3.6	
,,	,, ...	M	,,	5.3	
,,	,, ...	B	,,	7.0	
,,	Across the Bay towards Woodstock ..	S	,,	9.3	
,,	,, ,, ,, ..	M	,,	7.6	
,,	,, ,, ,, ..	B	,,	4.0	

Date.	Locality.	Depth.	Temperature.	Quantities in c.c.	Number of Phyllosomas.
23 Sept., '13	Across the Bay towards Milnerton ..	S	54	6.6	
,,	,, ,, ,, ..	M	,,	4.0	
,,	,, ,, ,, ..	B	..	7.4	
,,	Off Mouille Point Lighthouse	S	,,	4.2	
,,	,, ,, ...	M	,,	4.1	
,,	,, ,, ...	B	,,	8.2	
26 Sept., '13	Across the Bay to Milnerton	S	54	6.0	
,,	,, ,, ...	M	,,	6.6	
,,	,, ,, ..	B	,,	8.3	
,,	Along the Milnerton shore	S	,,	16.6	
,,	,, ...	M	,,	5.8	
,,	,, ...	B	,,	14.8	
30 Sept., '13	Across the Bay from Milnerton	S	52	22.0	
,,	,, ,, ...	M	,,	16.3	
,,	,, ,, ...	B	,,	17.0	
,,	Off Milnerton shore	S	,,	16.6	
,,	,, ...	M	,,	16.0	
,,	,, ...	B	,,	17.0	
7 Oct., '13	Off Milnerton shore	S	53	10.3	
,,	,, ...	M	,,	8.0	
,,	,, ...	B	,,	16.0	
13 Oct., '13	Mouille Point Lighthouse	S	53	47.2	
,,	,, ,, ...	M	,,	27.3	
,,	,, ,, ...	B	,,	34.8	
18 Oct., '13	,, ,, ...	S	52	29.0	
,,	,, ,, ...	M	,,	28.0	
,,	,, ,, ...	B	,,	19.8	
21 Oct., '13	Past Mouille Point Lighthouse	S	51	28.9	
,,	,, ,, ...	M	,,	24.0	
,,	,, ,, ...	B	,,	19.8	
25 ,,	Off Mouille Point	S	52	37.2	
,,	,, ...	M	,,	23.2	
,,	,, ...	B	,,	26.6	
28 Oct., '13	Mouille Point Lighthouse to Robben Island	S	,,	12.6	
,,	,, ,, ,, ,, ..	M	,,	15.0	
,,	,, ,, ,, ,, ..	B	,,	17.6	
1 Nov., '13	Between Mouille Point Lighthouse and Robben Island.	S	54	31.4	
,,	,, ,, ,, ,, ..	M	,,	29.8	
,,	,, ,, ,, ,,	B	,,	18.1	
4 Nov., '13	Off Robben Island, about $\frac{1}{5}$ mile from shore	S	52	24.8	
,,	,, ,, ,, ,, ..	M	,,	25.6	
,,	,, ,, ,, ,, ..	B	,,	13.2	
8 Nov., '13	Off Robben Island, about $\frac{1}{8}$ mile from shore	M	53	12.3	
,,	,, ,, ,, ,, ..	B	,,	24.0	
11 Nov., '13	Off Robben Island	S	60	52.2	
,,	,, ...	M	,,	33.1	
,,	,, ...	B	,,	27.3	
15 Nov., '13	From Somerset Hospital to Mouille Point Lighthouse.	S	53	24.8	
,,	,, ,, ,, ,, ..	M	,,	12.3	
,,	,, ,, ,, ,, ..	B	,,	24.8	
19 Nov., '13	Woodstock pipe	S	..	8.2	
,,	,, ...	M	..	2.4	
,,	,, ...	B	..	..	

Date.	Locality.	Depth.	Temperature.	Quantities in c.c.	Number of Phyllosomas.
5 Dec., '13	Green Point	S	53	1.6	
,,	,, ...	M	,,	1.6	
,,	,, ...	B	,,	27.1	
9 Dec., '13	Breakwater to Robben Island	S	..	19.8	
,,	,, ,, ...	M	..	11.6	
,,	,, ,, ...	B	..	11.6	
22 Dec., '13	Robben Island	S	53	6.2	2
,,	,, ...	M	,,	16.5	2
,,	,, ...	B	,,	5.8	8
30 Dec., '13	Breakwater to Woodstock pipe	S	56	90.3	10
,,	,, ,, ...	M	,,	64.6	3
,,	,, ,, ...	B	,,	33.6	2
10 Jan., '14	Green Point to Breakwater	S	55	35.6	121
,,	,, ,, ...	M	,,	38.9	57
,,	,, ,, ...	B	,,	..	210
14 Jan., '14	Breakwater to wreck	S	57	48.8	2764
16 Jan., '14	Pier to wreck	S	56	4.9	28
,,	,, ...	M	,,	16.5	3
,,	,, ...	B	,,	8.2	16
20 Jan., '14	Robben Island	M	57	11.8	981
,,	,, ...	B	,,	69.6	597
28 Jan., '14	,, ...	S	53	11.6	2
,,	,, ...	M	,,	10.7	3
,,	,, ...	B	,,	23.2	28
30 Jan., '14	Breakwater to wreck	S	55	64.6	12
,,	,, ...	M	,,	54.6	87
,,	,, ...	B	,,	59.6	279
3 Feb., '14	Green Point to Breakwater	S	57	72.9	470
,,	,, ,, ...	M	,,	..	1410
,,	,, ,, ...	B	,,	11.6	45
7 Feb., '13	Breakwater to wreck	S	53	..	8
,,	,, ...	M	,,	..	16
,,	,, ...	B	,,	..	43
10 Feb., '14	Robben Island	S	55	13.2	13
,,	,, ...	M	,,	10.7	4
,,	,, ...	B	,,	10.7	27
12 Feb., '14	Woodstock pipe to Breakwater	S	..	26.5	
,,	,, ,, ...	M	..	..	
,,	,, ,, ...	B	..	11.7	
,,	Breakwater towards Robben Island ..	S	..	24.8	
,,	,, ,, ,, ..	M	..	23.2	
,,	,, ,, ,, ..	B	..	45.5	
20 Feb., '14	Robben Island	S	57	27.3	
,,	,, ...	M	,,	14.9	
,,	,, ...	B	,,	24.4	
24 Feb., '14	,, ...	S	59	8.2	
,,	,, ...	M	,,	11.6	
,,	,, ...	B	,,	8.2	
27 Feb., '14	Robben Island and Breakwater to wreck	S	,,	29.0	
,,	,, ,, ,, ,, ..	M	,,	24.8	
,,	,, ,, ,, ,, ..	B	,,	28.1	
3 Mar., '14	Robben Island	S	60	6.6	
,,	,, ...	M	,,	5.8	
,,	,, ...	B	,,	9.1	

Date.	Locality.	Depth.	Temperature.	Quantities in c.c.	Number of Phyllosomas.
10 Mar., '14	„	S	59	9.1	
„	„	M	„	6.7	
„	„	B	„	19.8	
„	Breakwater towards Green Point ..	M	„	5.8	
„	„ „ „	B	„	7.4	
16 Mar., '14	Across the Bay towards the Breakwater	S	55	3.3	
„	„ „ „ „ ..	M	„	4.1	
„	„ „ „ „ ..	B	„	2.4	
„	Robben Island	S	„	9.9	
„	„	M	„	11.6	
„	„	B	„	13.2	
21 Mar. '14	From the middle of the Bay towards the Breakwater.	S	55	16.2	
„	„ „ „ „ ..	M	„	..	
„	„ „ „ „ ..	B	„	9.1	
„	From Robben Island towards the Breakwater	S	„	19.8	
„	„ „ „ „ ..	M	„	12.7	
„	„ „ „ „ ..	B	„	15.7	
26 Mar., '14	From the Breakwater to wreck	S	..	13.2	
„	„ „ „	M	..	5.8	
„	„ „ „	B	..	4.1	
1 April, '14	From the Breakwater towards Robben Isl'd	S	59	8.2	
„	„ „ „ „ ..	M	„	4.9	
„	„ „ „ „ ..	B	„	5.8	
„	From Robben Island towards the Breakwater.	S	„	9.9	
„	„ „ „ „ ..	M	„	5.8	
„	„ „ „ „ ..	B	„	13.2	
4 April, '14	„ „ „ „ ..	S	60	..	
„	„ „ „ „ ..	B	„	4.9	
„	From the middle of the Bay towards the Breakwater.	M	„	4.1	
„	„ „ „ „ ..	B	„	2.4	
7 April, '14	From Robben Island towards Mouille Point Lighthouse.	S	58	16.5	
„	„ „ „ „ ..	M	„	18.2	
„	„ „ „ „ ..	B	„	14.9	
„	From the Mouille Point Lighthouse towards the Breakwater.	S	„	7.4	
„	„ „ „ „ ..	M	„	9.1	
„	„ „ „ „ ..	B	„	4.9	
14 April, '14	Robben Island towards the Breakwater..	S	60	4 9	
„	„ „ „	M	„	6.6	
„	„ „ „ „ ..	B	„	7.4	
„	From the middle of the Bay towards the Breakwater.	S	„	6.6	
„	„ „ „ „ ..	M	„	5.5	
„	„ „ „ „ ..	B	„	3.3	
18 April, '14	From Robben Island towards the Breakwater.	S	59	6.6	
„	„ „ „ „ ..	M	„	10.7	
„	„ „ „ „ ..	B	„	1.3	
„	From Breakwater towards Robben Island	S	„	4.1	
„	„ „ „ „ ..	M	„	8.2	
„	„ „ „ „ ..	B	„	5.8	

Date.	Locality.	Depth.	Temperature.	Quantities in c.c.s	Number of Phyllosomas.
21 April, '14	From the Middle of the Bay towards the Breakwater.	S	60	5.6	
,,	,, ,, ,, ,, ..	M	,,	4.8	
,,	,, ,, ,, ,, ..	B	,,	4.9	
,,	From Robben Island towards the Breakwater.	S	,,	4.1	
,,	,, ,, ,, ,, ..	M	,,	4.9	
,,	,, ,, ,, ,, ..	B	,,	5.8	
25 April, '14.	,, ,, ,, ,, ..	S	58	11.4	
,,	,, ,, ,, ,, ..	M	,,	6.6	
,,	,, ,, ,, ,, ..	B	,,	8.2	
,,	From the Breakwater towards Robben Island.	S	,,	7.4	
,,	,, ,, ,, ,, ..	M	,,	5.5	
,,	,, ,, ,, ,, ..	B	,,	4.1	
28 April, '14	From Robben Island towards the Breakwater	S	56	6.6	
,,	,, ,, ,, ,, ..	M	,,	4.9	
,,	,, ,, ,, ,, ..	B	,,	6.6	
,,	From the middle of the Bay towards the Breakwater.	S	,,	4.9	
,,	,, ,, ,, ,, ..	M	,,	4.9	
,,	,, ,, ,, ,, ..	B	,,	4.9	
5 May, '14	From Robben Island towards the Breakwater	S	59	4.9	
,,	,, ,, ,, ,, ..	M	,,	7.4	
,,	,, ,, ,, ,, ..	B	,,	14.9	
,,	From the Breakwater towards Robben Isla'd	S	,,	8.2	
,,	,, ,, ,, ,, ..	M	,,	4.9	
,,	,, ,, ,, ,, ..	B	,,	4.1	
9 May, '14	Between the Breakwater and Robben Island	S	61	15.4	
,,	,, ,, ,, ,, ..	M	,,	16.5	
,,	,, ,, ,, ,, ..	B	,,	17.1	
,,	From the middle of the Bay towards the Breakwater.	S	,,	9.9	
,,	,, ,, ,, ,, ..	M	,,	8.2	
,,	,, ,, ,, ,, ..	B	,,	4.9	
16 May, '14	From the Breakwater towards Robben Isla'd	S	60	15.7	
,,	,, ,, ,, ,, ..	M	,,	14.0	
,,	,, ,, ,, ,, ..	B	,,	20.7	
,,	From Robben Island towards the Breakwater	S	,,	9.9	
,,	,, ,, ,, ,, ..	M	,,	20.9	
,,	,, ,, ,, ,, ..	B	,,	31.4	
23 May, '14	From the middle of the Bay towards the Breakwater.	S	57	6.0	
,,	,, ,, ,, ,, ..	M	,,	6.5	
,,	,, ,, ,, ,, ..	B	,,	4.0	
,,	From Robben Island towards the Breakwater	S	,,	14.3	
,,	,, ,, ,, ,, ..	M	,,	11.2	
,,	,, ,, ,, ,, ..	B	,,	11.0	
26 May, '14	From the middle of the Bay towards the Breakwater.	S	..	18.2	
,,	,, ,, ,, ,, ..	M	..	54.6	
,,	,, ,, ,, ,, ..	B	..	66.9	

Date.	Locality.	Dep'h.	Temperature.	Quantities in c.c.	Number of Phyllosomas.
9 June, '14	From the Breakwater towards Robben Island	S	56	9.9	
,,	,, ,, ,, ,, ..	M	,,	12.4	
,,	,, ,, ,, ,, ..	B	,,	9.9	
,,	From Robben Island towards the Breakwater	S	,,	16 5	
,,	,, ,, ,, ,, ..	M	,,	11.6	
,,	,, ,, ,, ,, ..	B	,,	6.6	
20 June, '14	From the middle of the Bay towards the Breakwater.	S	54	9.1	
,,	,, ,, ,, ,, ..	M	,,	9.1	
,,	,, ,, ,, ,, ..	B	,,	6.6	
,,	From Robben Island towards the Breakwater	S	,,	14.0	
,,	,, ,, ,, ,, ..	M	,,	32.3	
,,	,, ,, ,, ,, ..	B	,,	16.5	

4. The "Puerulus" or "Natant" Stage of the Cape Crawfish.

This may be recognised by its very transparent, glassy body, though otherwise superficially resembling a miniature crawfish. The following is a preliminary note of this stage, details of which will be published later. The body is not entirely colourless, but has patches of the bright red colour seen in the earlier stages (*phyllosoma*). These are very conspicuous on the ventral side of the animal near the base of the legs, and on the under side of the thorax. This colouring matter completely disappears very soon after the animal is dead, and preserved specimens retain it only for a few hours if exposed to light. There are fewer spines on the shield, and the "swimmerets" of the tail are well developed, each consisting of a relatively large expodite and endopodite, the latter provided with a coupling mechanism. These serve as swimming organs in place of the outer branches of the walking legs, which have now disappeared, leaving only rudiments or stumps in their place. In the adults the "swimmerets" have never been observed to function as swimming organs, being very much reduced in the male, and converted into egg-bearing organs in the female. The gills in the puerulus have become greatly developed, and are now covered by the enlarged shield. The change in the position of the gills is of interest. In the phyllosoma there are two on the upper side of the thorax (pleurobranchs), and one on the joint between the thorax and leg (arthrobranch). In the adult there is one pleurobranch and

two arthrobranchs, just the reverse of the condition shown in the phyllosoma. In the puerulus there are three, which may be said to occur on the side of the body, and later stages show that a new and enlarged joint is found, on which the two lower gills are situated, while the third becomes surrounded by the calcareous material, which is deposited on the side of the thorax and separates it well from the other two. The puerulus is quite devoid of calcareous deposits. The dimensions and proportions of the body are of interest. The smallest puerulus is very much smaller than the largest phyllosoma, and the largest is larger than the smallest stage at which the adult colouring and calcareous deposits occur—for convenience, this might be called the calcareous stage. The length of the carapace, in proportion to the total length of the animal, becomes greater throughout the various stages, and this is continued even through successive calcareous stages.

The stages through which the Cape crawfish passes after hatching are, therefore, as follows :—

1. *The naupliosoma*, in which the antennæ are biramous locomotory appendages, provided with long swimming setæ, the other appendages being relatively short and devoid of swimming setae.
2. *The phyllosoma*, in which the antennæ become uniramous and lose their swimming setae, the other appendages becoming suddenly relatively elongated, and the outer branch of the walking legs developing swimming setae.
3. *The puerulus*, in which the antennules are relatively smaller the antennæ large and uniramous. The pleopods are biramous and act as swimming organs. There are only a few spines on the carapace.
4. *The calcareous stage*, in which deposits of carbonate of lime appear in the cuticle. The pleopods become reduced, and lose their swimming functions.

The complete life history of the Cape crawfish is not, however, yet known, there being several gaps in the series of specimens procured. Thus, no stages have been found between the phyllosoma of 3·8 mm. in length and those of 24 mm. From this the series is fairly complete up to 37 mm.

The largest gap, however, is between the oldest phyllosoma and the puerulus. Whether or not the puerulus with its much-shortened body and legs, its curved shield, etc., at a single moult assumes these characteristics. is as yet unknown.

Early stages of the Cape Crawfish, (*Jasus lalandii*): 1, the first stage after hatching (Naupliosoma); 2, the second stage (Phyllosoma); 3, a more advanced Phyllosoma; 4, the Puerulus stage. 1 and 2 are 8 times natural size, 3 and 4 $1\frac{1}{3}$ times. From photographs.

IV.—DESTRUCTION OF FISH AND FISH SPAWN BY NETTING IN THE BERG RIVER AND AT KNYSNA.

A. Berg River.

The question of the alleged destruction of young fish and fish eggs in the Berg River has recently become an important one in the fishing industry of that locality, and has called for a good deal of investigation and enquiry on the part of the Administration. The statements of the interested parties have been so varied and contradictory that independent evidence has been necessary. An enquiry by the Magistrates of the districts directly concerned was held, and a good deal of information was obtained from the various witnesses examined. An independent investigation of the alleged facts of the case was also made by the Department, and some other points in dispute cleared up in a report on the subject. The object of the present note is to record in more detail than was possible in this report the facts of the case and the result of this investigation.

The Berg River is, next to the Orange River, the chief watercourse on the west coast of South Africa. It is characterised by the large extent of its tidal part, sea-water having on occasion been found as far as fifteen miles inland. In this part there are extensive flat areas or "plaaten" over which the water extends, and these, with the main channels of the river, form the feeding and (some allege) the breeding grounds for multitudes of salt water fish. The sea-water does not usually extend so far inland, and sometimes fresh water is found at the mouth of the river in heavy floods. Sea-water is, however, usually found four or five miles from the sea.

This extensive estuarine section of the river has from time immemorial been the fishing ground of a number of fishermen, who capture the fish by seine and set nets. There are, it is stated, at the present time 27 boats working in the river and about 1,000 persons dependent on them for a living. Some of the boats on the river go to sea, especially in the Snoek season, but the 27 boats are not sea-going boats. The fishing in the river all the year round is, according to this evidence, therefore, fairly extensive.

Naturally enough, some conflict of interests was liable to arise between the river fishermen and the sea fishermen, especially on any indication of the falling-off of the supply from the sea, and in the year 1897 representations were made to Government by those interested in sea fishing that the netting was doing damage to the fishing industry generally,

more especially by the placing of set nets across the main channels of the river, thus preventing the fish having access to their feeding and spawning grounds. A Proclamation was accordingly issued forbidding the placing of such nets in the main channels of the Berg River, on the ground that whether or not the river is the feeding and spawning ground of the fish, it was undesirable that it should be blocked to their ingress.

Under the Fisheries Ordinance of 1912 this regulation lapsed, but on representations from the fishermen, was re-enacted under a somewhat different form, as follows :—

> " Within the limits of the fishing area defined in Proclamation No. 115 of 1912 (the Berg River from its mouth to the ebb and flow drift, known as Wilgenboschdrift, in the Division of Malmesbury, including all tidal creeks between the mouth and the said drift) no person shall fish in the main channels of the Berg River with any kind of net other than seine or trek net ; but staked or drift nets may be used in such waters of the so-called flats, plaaten or backwaters of the said river as are not parts of the main channels."

At a later date, representation was made to the Administrator that the fish supply in St. Helena Bay and its neighbourhood was falling off considerably, and this was believed to be due to netting operations in the Berg River. It was stated that in the opinion of the " best fishermen," Harders come into the river to spawn, and these spawning fish, as well as young fish, are disturbed and destroyed to such an extent that the general fish supply is affected. On the other hand, this was controverted by the river fishermen, who state that sea fish seldom visit the river, and that they never find any salt water fish in the river in roe. The scarcity of fish is due, they say, to the scaring methods employed by the Italians, and also to the explosion of the bombs used by the whalers. That there has been a falling-off in the supply is admitted by most fishermen, and seems to be established by statistics of the catches of Harders and " Bokkoms." Some, however, maintain not only that there has been no falling-off, but that there has been an increase at some places.

For the sake of clearness, the various points at issue may be set forth :—

(1) Is there a marked decrease in the supply ?
(2) Are sea fish found in the Berg River ?
(3) Are sea fish in roe found ?
(4) Do they deposit their eggs in the river ?
(5) If so, are these destroyed by netting ?
(6) Are their young destroyed by netting ?
(7) Are immature fish destroyed by netting ?

With regard to the decrease in the supply, the only evidence available is verbal statements, and the more valuable evidence afforded by figures of catches of Harders and Bokkoms from the year 1880 to 1913, supplied by Messrs. Stephan. These figures are as follows :—

St. Helena Bay (from Paternoster to Berg River Mouth). Quantities of Fish Netted by Messrs. Stephan Bros.

Year.	Harders.	Bokkoms.
1880	164,720	427,975
1881	256,765	558,000
1882	186,340	649,750
1883	64,905	1,944,600
1884	44,125	1,558,575
1885	84,280	880,825
1886	84,430	933,300
1887	40,425	981,875
1888	60,475	745,700
1889	140,330	680,850
1890	94,820	364,725
1891	81,599	574,625
1892	108,902	914,350
1893	155,203	811,125
1894	159,177	539,575
1895	32,534	230,475
1896	47,465	464,125
1897	56,552	75,975
1898	86,402	57,075
1899	118,546	120,725
1900	91,882	141,235
1901	55,934	152,285
1902	11,185	16,470
1903	11,199	62,025
1904	9,542	104,575
1905	16,149	78,990
1906	50,368	60,775
1907	54,896	36,344
1908	60,831	210,989
1909	46,242	191,842
1910	12,125	70,855
1911	31,400	61,975
1912	17,263	54,200
1913	8,436	18,725

One of the most striking features of these figures is the erratic nature of the fluctuation in the supply. In four years —1880 to 1883—there was a steady increase in the supply of "Bokkoms"—from about 400,000 to nearly 2 millions. The following year the quantity was less, but still relatively very large. Thereafter nothing like this quantity was obtained. There is no apparent cause for this sudden increase and equally sudden decrease, but it would seem that it could not have been due to any particular methods of fishing, and was entirely beyond control.

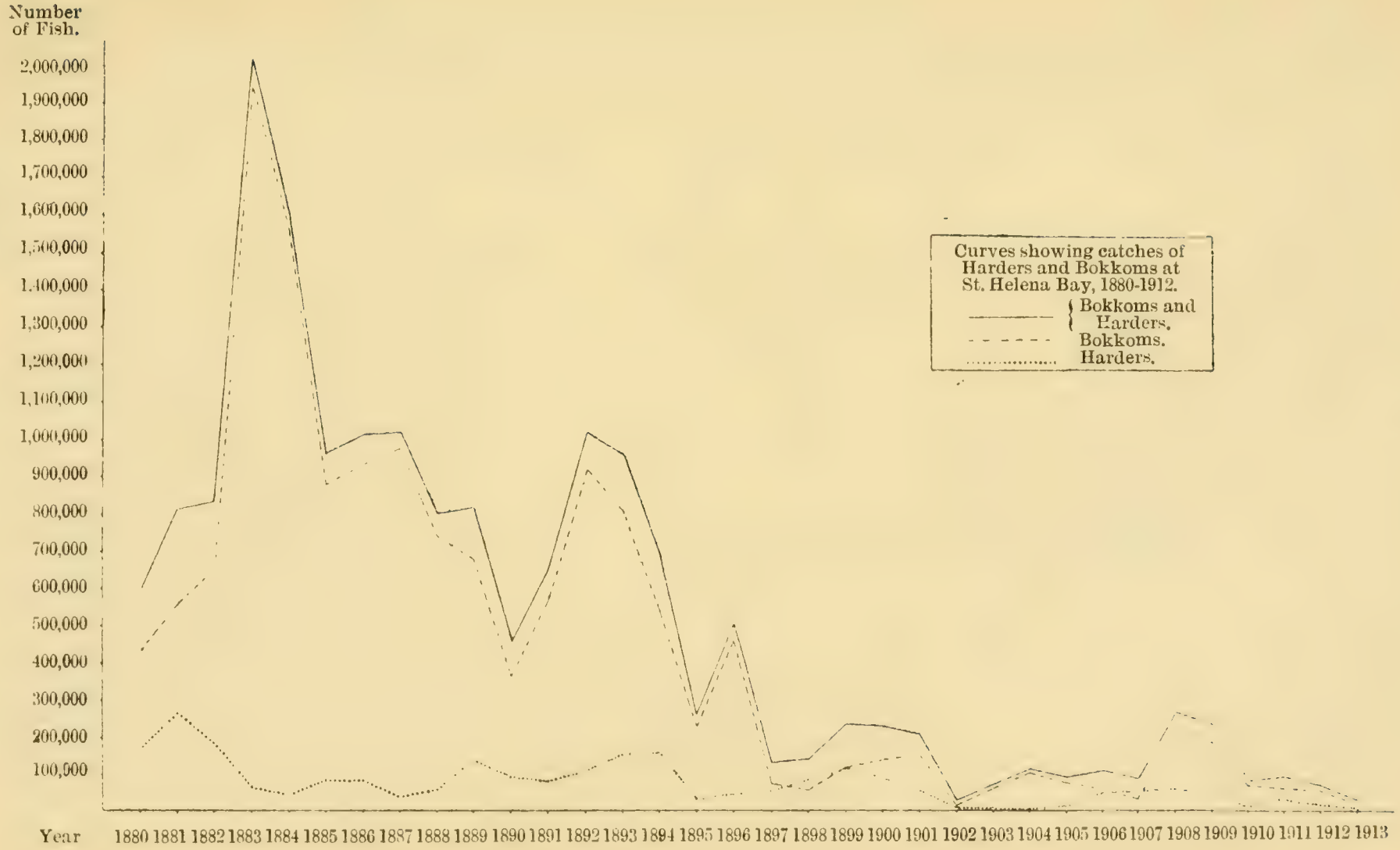
The figures fall more or less steadily towards the year 1890 and increase suddenly in 1892. From this date there is a more or less gradual falling-off. From 1897 to 1912 there cannot, however, be said to be a falling-off, indeed, the supply is greater in 1908 than in any year since 1890, and the figures for 1902 are the lowest on record.

With regard to the adult fish or "Harder," it is to be noted, in the first place, that they are caught in much fewer numbers and, secondly, that they do not show the same marked falling-off in numbers as the young forms. Again, their years of maxima and minima, as a rule, do not correspond with those of the "Bokkom," though in 1895 and 1902 the minima of both occurred in the same year, and in 1908 the maxima.

An interesting feature of these data is that there is a certain periodicity in the occurrence of the good years. Thus, for "Harders" and "Bokkoms," taken together, the relatively best years were 1883, 1887, 1892, 1896, 1900, 1904, 1908, or intervals of 4, 5, 4, 4, 4, 4 years respectively, though it is to be noted that no outstanding good year has occurred subsequent to 1908. According to this, 1912 or 1913 should have been good years. These facts, which may prove to be of importance, may be represented by the accompanying curves, the periodicity being more clearly indicated in the "smoothed" curve.

With regard to the figures as a whole, there is undoubtedly a marked falling-off in the supply indicated, assuming their relative accuracy and an approximately equal or at least not diminishing number of men employed. The falling-off, however, may have been local in its occurrence and some of the witnesses examined stated that the supply had increased at other places, such as Hoetjes Bay.

With regard to the occurrence of sea fish in the Berg River, statements are conflicting, but the experimental hauls made by the Government may be taken as reliable evidence on this point. In one of these latter, near the mouth of the river, 12 Gurnards (*Trigla kumu*), 2 White Steenbras (*Pagellus lithognathus*), 2 White Stumpnose (*Chrysophrys globiceps*)—


Number of Fish.
2,000,000
1,900,000
1,800,000
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
Year
1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913
Curves showing catches of Harders and Bokkoms at St. Helena Bay, 1880-1912.
Bokkoms and Harders.
Bokkoms.
Harders.

Number of Fish.
2,000,000
1,900,000
1,800,000
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
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Year
1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912
"Smoothed" curves showing catches of Harders & Bokkoms at St. Helena Bay, 1880-1912.
Bokkoms and Harders
Bokkoms.
Harders.

not to be confused with the White Stumpnose of Knysna and the Zwartkops River which is *Sargus holubi*—and two Baggers (*Galeichthys feliceps*) were found. These are characteristic sea fish. Another haul taken in the river five miles from the mouth included 200 Elft (*Temnodon saltator*); one taken nine miles from the mouth, in fresh water, included none of these fish, and consisted of "Bokkoms," which are young Harders (*Mugil capito*) and "Assous" (*Spratteloides aestuarius*). The occurrence of Harders in the fresh water is of interest, as this is one of the points in dispute. It may, therefore, be concluded that sea fish are fairly abundant in the river, at least at this particular season (January).

It is stated by some that Kabeljaauw (*Sciaena aquila*) were formerly abundant in the river; Hottentot (*Cantharus blochii*) and "Rock Fish" are said to be absent.

The Josef (*Callorhynchus antarcticus*) does not seem to be found in the river, though so abundant on the coast here that occasionally large haul are made by seine nets. Their capture is unintentional, as they are useless as a food fish.

It is disputed that sea fish are ever found in roe in the river, and none of the sea fish in the hauls made were in this condition, except the Baggers, of which some were found with eggs. From experimental hauls made in the Zwartkops River, it seems that these fish, whose spawning habits are peculiar, sometimes, at least, ascend well up into the tidal river at spawning times. From the data procured from the hauls, one might conclude that, with the exception of the Bagger, sea fish are not in roe in the river, but from investigation into the next question, it is indicated that not only do they occur in roe, but the eggs are actually deposited in the river.

These eggs were found in a series of tow-nettings in the river. About two miles up the river, at ebb tide, 12 fish eggs were procured in about four hauls of the net, lasting in all about half-an-hour, and further up the river fish eggs were again found in about the same numbers. The net was only about a foot wide at its open end, and it is therefore evident that fish eggs must be abundant in the river at this season.

The eggs procured were of two kinds, one with a diameter of ·85 to ·90 mm. and with a single oil globule of ·21 mm.; a second measured ·80 to ·82 mm. in diameter and had from 5 to 7 small oil globules of ·08 to ·12 mm. From previous investigation at the Marine Laboratory, St. James, the first kind would appear to be the eggs of the Kabeljaauw (*Sciaena aquila*), which were found to measure from ·91 to ·82 mm. with a single oil globule (about 10 per cent. had two) of ·2 to ·19 mm. (*Vide* Marine Investigations in South Africa, Vol.

III, p. 150.) The second kind resembles the eggs of the Sole (*Synaptura pectoralis*), which measure ·81 to ·72 mm. in diameter and have several oil globules from 1 (rare) to 12 in number, and varying in diameter from ·15 to ·04 mm. The number of oil globules, however, is much less than is usual in the egg of this Sole.

The condition of the eggs showed that they had recently been shed, the germinal disc having only a few divisions, and as they were taken at ebb tide, it may be concluded that they were shed from the parent fish in the river.

These floating fish eggs are very small and transparent and can with difficulty be seen by the naked eye, even when held up to the light in a glass tube with water, and it is therefore not to be expected that fishermen would be aware of their presence in the river.

Another kind of fish egg is, however, well known to the fishermen, being of a large size, about $\frac{1}{4}$ inch in diameter. This is the egg of the " Bagger " (*Galeichthys feliceps*), a fish which has a quite unique method of reproduction. The eggs are frequently found in hauls of the net, and in the boats, in which the fish have been placed. They are even got in bucketfuls occasionally in the boat, and make excellent food for the fishermen's poultry. The fact that the eggs are found in the mouth of the fish is a striking feature and a good deal of discussion has taken place locally as to how they get there. The facts of the case are that the eggs, when laid, are taken by the male into his large mouth and kept there till they hatch out ; they may be found there in all stages, from the simple egg to the larvæ with yolk sack still attached, and even well-developed young fish, without yolk sac, find shelter for a time in this paternal brood chamber. This being the only case of fish eggs being found in the river by fishermen, it has been concluded that other fish " spawn " may be of the same nature, but this inference is incorrect.

With regard to the next question, as to whether the eggs of fish in the river are destroyed by netting, there does not seem to be any possibility of this in the case of the minute eggs described, and in the exceptional case of the Bagger, though damage may be done, it is not of serious consequence, as the fish is of little commercial value,

The same holds good of the larvæ or young hatched from these eggs.

A more serious question is the alleged destruction of the older but still immature fish. Here again the testimony of fishermen is conflicting, and the experimental hauls already referred to may be taken as the only trustworthy evidence.

The most important fish in this respect is the "Harder" and the "Bokkom Harder." It has been alleged by some fishermen that the Bokkom is a small but distinct kind of Harder, and is not merely the young of the ordinary Harder. A Bokkom of seven inches in length is considered a fair size, and one of 9½ or 10 inches a large one. Harders are from 12 to 17 inches in length. After careful examination of both kinds, it appears certain that they are the same fish (*Mugil capito*), and not different species, or even varieties. In the haul in the river not far from its mouth, 1,000 Bokkoms were caught of 7 to 9 inches in length; five miles from the mouth 120 Bokkoms were procured of 7 to 9½ inches in length, and nine miles from the mouth, in fresh water, 40 were procured of 7 to 9 inches. In a haul from the seashore, outside of the river, 4,000 Harders were procured of 12 to 17 inches in length; most of these were mature fish, chiefly spent females, the rest being males and a few Bokkoms. One female of 17 inches was in full roe. It will be seen from the figures already given of the catches of Bokkoms and Harders from Paternoster to Berg River mouth that the proportion of the first to the second in sea fishing is usually very unequal—the number of Bokkoms being, on an average about seven times the number of Harders.

Undoubtedly, the Harders caught in the river are mostly Bokkoms, that is, immature Harders, but the total number of these is very much less than that of those caught in the sea at the various fishing stations on the coast. If, therefore, there is any serious diminution in the supply of the Harder generally, due to the catching of immature forms, it is to be attributed more to the operations of the sea fishermen than the river fishermen. It may be said that the latter cause greater damage, as they capture smaller Bokkoms than the sea fishermen. If, however, the fish has not spawned once at least, equal damage is caused by the capture of a large and of a small form.

The question of the scaring of fish has been raised by some of the fishermen at the Berg River. It is stated that the use of seine nets scares the fish in the river, disturbing them in their feeding or spawning ground. More definite information as to the possibility of scaring fish is afforded in the dispute between the native and the Italian fishermen. On the west coast the latter are said to drive the fish into the nets by various devices, such as splashing of oars and rattling of tins placed in the water. The effect of this, the native fishermen allege, is not only to drive the fish into the nets, but to frighten them off to sea, so that they will not readily approach the shore, where they can be procured by the ordinary shore nets used

by the native fishermen. The Harder fishermen in False Bay also state that this fish can readily be alarmed and driven off into the open sea. Whether or not this may occur on the firing of heavy guns or the running of trains may be disputed, but that the fish may be easily driven off is not open to question, as it had become a practice, until forbidden by law, to scare off fish from particular trek (seining) grounds by the splashing of oars or by other commotion in the water. Thus, if the fish passed the Simon's Town trekking ground too far off to be captured, the fishermen then put off in a boat and drove the fish out to sea by those methods, so that they were prevented from coming into the Fish Hoek and other trekking grounds. This operation is locally known as "keering," or turning the fish out of their course. The Harder is not only a timid fish, but exhibits an amount of intelligence which can only be appreciated by the practical fisherman, who has to pit his wits against those of his prey. Experienced fishermen in False Bay, where this class of fishing is extensively carried on, state that they have to use the greatest caution in the capture of a school of Harders. A boat incautiously put off, or other mistake, will drive the fish off to a rocky bottom, where, as they seem to be well aware, the net cannot be used. It is said also that it is becoming increasingly difficult to capture the fish inshore though they are known to be in abundance out in deeper water, where the present nets cannot be used. It has been the experience of the seine netters that they have, in course of time, to put their nets farther out to sea. In fact, the evidence seems to indicate that the apparent decrease in this case is not due to the lessening of the number of fish, but to greater difficulty in catching them on account of their increasing wariness.

B. Knysna.

The conditions as regards fishing, both with reference to locality and kinds of fish, at Knysna are different from those at the Berg River. The extent of the fishing operations is also much smaller, being limited to a few fishermen, who also find employment in other directions. These fishermen sometimes, though rarely, cross the rather dangerous bar at the mouth of the river, and do some fishing by hook and line in the sea. The fishing operations are thus chiefly confined to seine-netting in the river, there being, however, only four or five nets. The limited extent of fishing operations is no doubt due to there being no means of conveying the fish inland, and they are disposed of chiefly in the village of Knysna.

There is no river here comparable to the Berg River, but rather a long broad lagoon or harbour of a very considerable extent, usually filled with sea-water, the fresh water part of the river being relatively of a very limited extent. The Harder is not the fish of chief importance here, but the White Stumpnose (*Sargus holubi*), and the White Steenbras (*Pagellus lithognathus*), the former especially. Next in the order of importance are the Harder, the Kabeljaauw, Streepje (*Box salpa*), Elft (*Temnodon saltator*), etc.

The same complaints of increasing scarcity of fish are raised here by a certain section of the community, and the cause is said to be the operations of the netters, as they catch large quantities of immature fish. It is of special interest as bearing directly on the Berg River difficulty, that no complaints are made of the capture of immature Harders, and that the nets in use are well over the present legal size by about half an inch, the mesh being about $1\frac{3}{4}$ inches, measured from knot to knot diagonally across the square, instead of the legal $1\frac{1}{4}$ inches. The absence of any complaints with regard to this fish is not due to its less abundance, but to the small forms not being captured, as was proved by a series of experimental hauls. If it be found desirable to check the capture of small Harders, this would seem to indicate that the most effective method of doing so is by increasing the legal size of mesh of net.

There seems to be a greater variety of Harders here than at the Berg River, where only the Springer (*Mugil constantiæ*) and the ordinary Harder (*M. capito*) were found. The fishermen distinguished them by various names, but much reliance cannot be placed on their distinctions, especially as they did not agree among themselves. From their description, the fish they know as the Springer is not the Springer of the Berg River, as they describe it as having a sharp snout. They state that the several kinds of Springers and Harders are as follows :—

(1) Dikkop-Springers, Dikkop-Harders, or Springer-Harders, characterised by their flat heads. They remain in the river, chiefly in the fresh-water portion, and seldom appear near the mouth except in a freshet.

(2) The Streep-Springer, characterised by a series of black stripes along the sides. Some fishermen say there are two kinds, a larger and a smaller. The Springer (both 1 and 2) are seldom caught in the seine nets, as they leap over them when surrounded. In summer, however, when they become fatter, they are not so active, and a few may be caught. On one occasion 120 Dikkop-Springers were caught in one cast of the net, and this was considered a record.

(3) The Sea-Harder or Greenback-Harder, characterised by its bluish colour, firmer flesh, and harder, whiter belly, is a sea fish, and comes into the rivers about October and leaves about December. In January it is very scarce in the river. It is the ordinary Harder of the sea coast (*M. capito*).

(4) The Streep-Harder or Kol-Harder, also called by some the Springer, is also a sea fish that comes up the river at times.

(5) The Mud-Harder, distinguished by its soft, large abdomen, remains in the river throughout the year.

(6) The Freshwater or River-Harder is thicker and larger than the Mud-Harder. The abdomen is harder, the eyes larger, and the head broader. It is of a light brown colour above and white below.

Harders are said, by the Knysna fishermen, " to go against the wind " in a South-Easter, and are found on the east bank of the river. A north-west wind brings them up the river. Most of the fish pass out and in from the sea, and, after a continuous and strong south-east wind, the river is full of fish and even Hottentots and Blauers, which are outside " rock fish " come into the river. The best time to catch fish in the lagoon is after a freshet and several days south-east wind.

Although the fish come into the river from the sea and pass out again, this is not true of all kinds, and there are many which never or seldom appear in the river. The following is a list of them as given by the fishermen :—

Geelbek (*Otolithus aequidens*).—Only one is known to have been found in the river.

Hottentot (Cartharus blochii).—Seldom in the river.

Blauer, Poenskop or *Poeskop* (Sargus Sp.)

Dageraad (*Chrysophrys laniarius*).

Roman (*Chrysophrys cristiceps*).

Silver-fish, or Seventy-four (*Dentex lineatus*).—Never found in the river. The " Silver-fish " of Knysna is not the fish of the same name at Kalk Bay and Table Bay, which is *Dentex argyrozona*.

Sandfish.—These are of two kinds, one red and one bluish. One is in the river and one in the sea. This seems to be the " Panga " (*Pagrus laniarius*), of Kalk Bay.

Red-stumpnose.—Apparently not the fish so-called at Cape Town.

Rooitje or Kaapenaar (*Dentex argyrozona*).—The silver fish of Kalk Bay.

Michael (*Chrysophrys gibbiceps*).—Called the Red-stumpnose at Kalk Bay.

Klip-fish, or King-klip-fish (*Genypterus capensis*).

Galjoen (*Dipterodon capensis*).

Baartman (*Umbrina capensis*).—Seldom caught in river.

The following fish are found both in the sea and the river :—

The White-stumpnose (*Sargus holubi*), a fish different from, though somewhat resembling the White Stumpnose (*Chrysophrys globiceps*) of Kalk Bay. It may be readily distinguished by its colour, being silvery without vertical dark bands, but with a yellow longitudinal band running along each side of the body, the ventrals and anals being of a bright yellow. These colours, however, soon fade, and are not so marked in the adult. Sargus can, however, readily be distinguished by its teeth from Chrysophrys. *Chrysophrys globiceps* also appears in the sea at Knysna, but apparently never in the river. *Sargus holubi* also occurs in the sea among the rocks, but is not caught by the fishermen there. It is a fish, therefore, for practical purposes confined to the river, and any damage which may be done to it by netting, cannot affect the sea-fishing. Some fishermen say, however, that they have seen all the other fish in the river with roe, but never the White-stumpnose. A specimen 17 inches in length caught near the mouth of the lagoon proved on dissection to be a mature male.

The White-steenbras (*Pagellus lithognathus*) is one of the most important fish found in the river. The full-grown fish is over three feet in length and, although very large ones are caught in the river, they are nearly all immature.

The Sand-steenbras (*Pagellus mormyrus*) is not so abundant as the White-steenbras, and does not grow to such a large size.

The Elft (*Temnodon saltator*) is fairly abundant.

The Leer-fish (*Lichia amia*) is frequently caught, but both this fish and the Elft are looked upon by the seine fishermen as pests, as they do considerable damage to the other fish.

The Bontrok (*Sargus servinus*) is found in the river. This fish is called the Wilde-paard or Zebra-fish at Kalk Bay.

The Dasje (*Sargus rondelettii*) is fairly common, both in the river and in the sea.

The Kabeljaauw (*Sciæna aquila*) is often caught in considerable numbers in the river and very large specimens, called the "Riet-bull" or "Boer-kabeljaauw," are occasionally caught, some being over 5 ft. in length.

The Knorhaan or Grunter (*Pristipoma operculare*) is common in the river and grows to a large size, but is never as large as the Steenbras.

The Varkje (*Pristipoma bennettii*), called " Grunter " at Kalk Bay, is mostly a sea fish, being seldom found in the river.

The Black-barger (*Galeichthys ater*) is found in the river.

The Red-barger or White-barger (*Galeichthys feliceps*) is found both in the sea and the river. The fishermen have observed that the Red-barger sheds its eggs when placed in the boat, but have never observed this of the Black-barger.

The Needle-fish (*Hemiramphus sp.*) is at times abundant in the river, and it is said to be very good eating.

It may be concluded from these lists that destruction of fish in the Knysna lagoon cannot affect a large number of sea fish, which do not, or rarely enter the river.

With regard to the capture of immature fish, a series of hauls were carefully examined, and the fish measured (from end of snout to tip of tail) with the following results :—

Name of Fish.	*Measurement.*
White-steenbras	12–36 inches.
White-stumpnose	4–12 ,,
Harders	10–25 ,,
Springers	24 ,,
Streep-harder	20 ,,
Leer-fish	18–36 ,,
Bontrok	6 ,,
Sand-steenbras	9–10 ,,
Streepjes	$7\frac{1}{2}$,,
Dasjes	9 ,,
Elft	13 ,,
Kabeljaauws	20 ,,

All of these, with the exception of the Harders, Springers and Streepjes were immature fish, and this proves that at this particular season (January), a considerable destruction of young fish does take place in netting operations. It can hardly, however, be looked upon as justifying a total prohibition of netting, though it seems advisable to discourage the taking of very small fish, which are of little or no value to the fishermen, and the following size limits are recommended :—

White-stumpnose	6 inches.
Steenbras	12 ,,
Elft	12 ,,

Very small Harders and Streepjes are not commonly captured, and the other fish are, as a rule, not sufficiently abundant to justify any restrictions as to size.

An examination of the fish did not afford any evidence that any were actually in spawn at the time, but a series of townettings proved that eggs and young of different kinds were fairly common in the water.

The most abundant were eggs of a diameter of ·71 to ·72 mm. with a large perivitelline space of about ·08 mm. No oil globules were seen in the yolk. Embryos of various stages, all showing a well-developed tail, free from the yolk, were contained in the eggs.

Along with these eggs, larvæ were procured, which seemed to belong to the same species of fish. They measured 1·5 to 1·8 mm. in total length. The rectum was close to the end of the elongated tail. The anterior end of the yolk sac was slightly behind that of the head. The length of the yolk is contained 2·7 times in total length, and much less than its distance from the end of the tail,which was 1·7 in total length. The distance between the rectum and the end of the tail was eight times in the total, so that the former was decidedly posterior. No oil globules were present, and the yolk showed slight traces of vesiculation. A few scattered black pigment spots occurred along the tail.

The nearest approach to this in size is species No. 28 (*vide* Mar. Inv. S. Africa, Vol. III, p. 140), which was the smallest egg found up to that date, being ·72 to ·76 mm. in diameter. It differs, however, from this egg in having a large perivitelline space. The larva of species 28 also has an anterior rectum. It differs from other known South African fish-eggs with a large perivitelline spawn, such as species 3, which has a diameter of 1·2 mm. and a single oil globule of ·2 mm. and species 10, which is 2·97 to 2·64 in diameter. As it seems to be well characterised it may be designated species 22 in continuation of the list of South African fish-eggs, the adults of which are unknown.

An egg 1·02 mm. in diameter with an oil globule of ·25 mm. approaches nearest to that of the Panga (*Pagrus laniarius*), which is recorded as from 1·1 to ·93 mm., oil globule ·2 to ·19.

Others, ·82 mm. in diameter, with 9 to 12 small oil globules, resemble most closely that of the Sole (*Synaptura pectoralis*), as also do others measuring respectively ·76 mm. with 9 oil globules from ·16 to ·04 mm., and ·76 with one oil globule ·17 mm. in diameter.

V. OBSERVATIONS ON THE HABITS OF SOME SOUTH AFRICAN FISHES.

So little is known of the habits and behaviour of marine animals generally that any trustworthy observations, even of an apparently trivial nature, may prove the solution of many practical and scientific problems, For instance, such questions as how and where fish spawn, feeding habits, rate of growth, etc., are at the basis of most of the difficulties that arise in fishery matters.

The facilities afforded at the Government Marine Biological Laboratory at St. James have rendered it possible to obtain some information on the habits of Cape fishes, which has already proved of practical service, and the following observations are a further contribution to this subject.

Many of the South African fishes are particularly well adapted for observation in captivity, owing to the fact that shore-frequenting species are well represented here, as, for instance, the family of the Sparidæ, which include forms with cutting teeth for the nibbling and seizing of food found on rocky ground, and molar teeth, for the crushing of shell fish and other salt-water animals with hard-protecting shells. While the Sparidæ are specially prominent in South Africa, less specialised forms, such as the Cod family (*Gadidæ*) are poorly represented, and this fact may perhaps be regarded as evidence of the greater specialisation and differentiation of fish life in South Africa. Their names need only be mentioned to show how many of the common fishes belong to this family : White-stumpnose, Red-stumpnose, Dageraad, Wildepaard, Steenbras, Hottentot, Dasje, Steenje, Bamboo-fish, Panga, Galjoen, John Brown, etc. These are essentially shallow water fishes, mostly frequenting the rocks, weeds, or sandy shores, and feeding on seaweed, small crustacea and molluscs, etc. It is chiefly owing to the abundance of such forms that amateur sea-fishing from the shore is so much more attractive in South Africa than in many other countries.

The two forms last mentioned may be taken first, as they represent genera peculiar to South Africa.

The Galjoen (*Dipterodon capensis, C. & V.*).

This fish is abundant in shallow water close inshore, especially in the summer season and, in spite of its being of a comparatively large size, about a foot or a foot and a-half in length,

and about half this in depth, it is often found actually in the breaking surf, and the curious spectacle may often be seen of an angler with rod and line procuring these large fish from the breakers among the rocks or even along a sandy beach. Its structure and habits, as observed in the aquarium, show how admirably adapted it is to this habitat. In shape it is laterally compressed and comparatively short, in contrast to its marked elevation of body, a feature which doubtless suggested its resemblance to the old high and stately Spanish galleon. It usually moves about the tank in a deliberate fashion, and the facility with which it can turn sharply round is very striking. The significance of the short high body becomes apparent when the fish is alarmed or rushes about after food; then, apparently with one or two undulations of its flat and powerful body, it passes like a flash across the tank, turning sharply with hardly any evident checking of its speed. It has been suggested that the flattening of the body from side to side as shown typically in the "John Dory" (*Zeus*), is an adaptation to escape observation, as, when looked at from in front, the body is rendered less conspicuous. Though two species of Dory occur in South Africa (*Z. capensis* and *Z. japonicus*), no opportunity has been obtained of observing this effect in these forms. In the case of the Galjoen, however, any advantage that may be derived by an apparent diminution of the real size of the body by this means seems to be more than counterbalanced by a side view. It appears rather that the flattening of the body from side to side is an adaptation by means of which the fish can make a sudden and rapid movement, which can also be as quickly checked and changed, a matter of the greatest importance in large fish of the littoral zone, and this may be in part at least an explanation of the general flattening of the body in most cases where, as in large shore forms particularly, a rapid and changing rather than a sustained flight is an advantage.

A further adaptation to its particular mode of life is observed in its ability to change its colour. It is usually of a dark colour when caught, but, if placed in a shallow, sandy pool, it quickly assumes a very light shade. Specimens, which have been transferred to a well-lighted tank with white enamelled tiles, quickly change from their original dark to a white silvery colour. Mr. Brooking, of East London, writes me that he has observed a very marked and rapid change of colour in the Galjoen, which, after being caught, he put into a pool with a white sandy bottom, and then into one with a dark bottom, the fish rapidly assuming the ground colour when placed in the one or the other.

The Galjoen becomes sometimes quite dark, almost black, in the tank, but, if suddenly startled or alarmed, it may become almost silvery white in less than half a minute. Like most fish, it also occasionally shows the dark pigment in broad vertical bands across the body. These are sometimes very marked, but exactly under what conditions they appear is not quite certain.

I may mention here another striking change in the colour and behaviour of the Galjoen at times, an almost exactly similar phenomenon to that observed in the case of several other members of this family, such as the Dasje, the Hottentot, the Wildepaard, and Steenje. It is observed almost always when the fish are in pairs. Two Galjoen may be seen swimming close to the bottom of the tank, often circling round each other, keeping to a restricted area, and displaying more interest in each other than usual. At such times the colour of both deepens, and becomes blacker. The relation between the two seems to be an amicable one, and may be concerned with reproduction, though in the case of the Steenje, noted below, this would not seem to be always the case.

The Galjoen is one of the South African fishes which is widely distributed throughout the South African coasts, and I have received specimens from Walfish Bay, East London and Natal. It is most abundant near the Cape.

John Brown (*Gymnocrotaphus curvidens*).

This is one of the most interesting of the family of the Sparidæ. Like the Galjoen, it is a genus peculiar to South Africa, and is generally found in the same localities. Its behaviour seems to indicate a greater degree of intelligence than appears in the others. Thus, it is one of the few fish in the aquarium that display any particular interest in their fellow creatures on the other side of the glass ; while other fish are on the hunt for food or swimming aimlessly about in the tank, this fish often comes to the observer and gazes with what seems a certain amount of intelligence and curiosity. Nor is it usually alarmed by any sudden movement ; most of the fish in the tank can be scared by the sudden flicking of a white cloth in front of them, when they crowd towards the observer for food ; the John Brown, however, will remain when all of the others have made off and, if the annoyance be continued, will frequently resent it, shaking his head and opening his mouth in a threatening manner.

Its colour is a bright yellowish brown, becoming darker with a tinge of purple on the head region. The eyes are of a bright

blue, which adds to the general intelligent look of the fish. The head region occasionally assumes a darker hue. Its generic name *Gymnocrotaphus* refers to the fact that the head and cheeks are devoid of scales.

It is well provided with a row of sharp, curved (hence specific name), closely-set cutting teeth, and it does not hesitate to use these effective weapons on any of its fellow fish who chance to incur its displeasure. It is, however, of a very social disposition towards fish of its own kind, and becomes greatly excited when another is introduced into the tank. On one occasion a single specimen was kept for a considerable time in a tank along with other fish, and showed every sign of pleasure when another of its kind was introduced, circling around it and assuming a peculiar attitude—the body held almost vertically with the head downwards, the tail fin and posterior part of the dorsal and anal fin keeping up a trembling motion. (Compare the same action observed in the Harder.) It also had previously shown exactly the same phenomenon when a painting of the fish itself was held up in front of the tank.

The only instance of a psychological state resembling amusement or hilarity in a fish was observed in the case of the John Brown. The interpretation of the observation may be erroneous, but the fact of the occurrence was as follows :—On one occasion a small Barbel, or Barger as it is sometimes called (*Galeichthys feliceps*) was put into the tank. Unlike the adults, small forms move about actively in the day time. Six long feelers project from the chin of this fish, and these seem to be its chief sensory organs in searching for food. This little fish, which moves busily about the tank, sweeping the ground with the long feelers, was on one occasion observed to be passing backwards and forwards over the John Brown lightly touching the surface of his sides and back with the points of the long feelers. The John Brown occasionally lay over on his side to facilitate this operation, and frequently became greatly excited, opening the mouth widely and extending the gill-covers on each side to their utmost, the whole body and fins occasionally quivering with excitement under the apparently tickling process. This sometimes became too much for him, and he would suddenly break away, still with shaking body and widely-expanded mouth and gill-covers. After a pause he would again seek out the Barbel, and the process was repeated till finally the Barbel left him, apparently after having removed the Copepods which occurred on his body.

These Copepods were not parasitic, but moved about freely on the skin of the fish, and could not have caused any serious

inconvenience. There is, however, a Crustacean (*Meinertia imbricata* which often brings about fatal results, not only in this fish, but in many others. The John Brown, on which the above observation was made, became subsequently duller in colour, less lively and seemed in distress. When taken out of the tank and examined, the cause was found to be the presence of this parasite. A simple operation was sufficient to remove it and the fish immediately recovered.

The eggs of this fish are of the usual pelagic type, small, transparent and floating.

It is usually ready to take any sort of food offered it, though it seems particularly fond of "red bait."

The Hottentot (*Cantharus blochii C.V.*).

This fish, like the Galjoen and John Brown, is provided with sharp, cutting teeth. It is of a dark sometimes bronze colour, to which it doubtless owes its local name. It is one of the most common-place fishes both in appearance and behaviour. It usually becomes a very light colour in the white-tiled tank, though, like the Galjoen, it occasionally becomes very dark.

In the case of this fish and also of another (the Bamboo-fish) a diseased condition was occasionally observed, caused apparently by a Protozoon. The fish got in low condition and small specks appeared over the body and fins. These could be readily examined microscopically by transmitted light in the fin. The largest were easily visible to the naked eye and consisted of a ciliated body much laden with granules, of a spheroid shape, but provided with a protrusible mouth part, which, as the animal revolved in the cavity in which it was contained, was applied to the surrounding tissue. The affected fish often recovered, but occasionally died apparently from the parasites affecting the gills. This parasite seemed different from any of the described Protozoan parasites of fishes.

The Steenje (*Cantharus emarginatus*).

This is a lively little fish, and lives well in the aquarium. It is somewhat of the same colour as the Hottentot. It is mentioned especially on account of certain observations which may have some bearing on change of colour. It is more gregarious than the Hottentot, and a group of about half a dozen in the tank usually kept together. Sometimes, however, two fish were found, not far from each other, remaining almost stationary, but with the tips of the fins keeping up an active movement, while the colour of the body became abnor-

mally dark. They were always within sight of each other, and generally in some sheltered place. On other occasions what appeared to be a combat was witnessed between two fish, which had assumed this same dark shape, but this always happened out in the open on the floor of the tank. The two fish circled round, finally settling down in a position facing each other, about a foot or a foot and a half apart. The affair seemed to consist more of threatened than actual infliction of injury. Their action resembled that of two cocks fighting, and consisted of a repeated dipping down of the head, and the general assumption of a threatening attitude. They, however, seldom came into actual conflict and, even when they made a rush at each other, generally sheared off, apparently before the contact. The end of such a contest, if contest it was, was never witnessed, and a few days afterwards they were seen swimming about amicably with the rest of the group as before, having lost their dark hues.

Another observation made on these fish is of interest as the only recorded instance, so far as I am aware, of fish eating Alcyonarians. On one occasion an Alcyonarian (*Cavernularia*) was introduced into the tank. It is a large fleshy form about a foot long, with a basal part, with which it slowly dug into the sand. After it had thus assumed an erect position, the polyps expanded fully to about half an inch. One of the Steenjes, after a careful survey, made a sudden dart at an extended polyp, seized it and, with a lateral jerk, tore it off. The fish, after a prolonged munching of its prey, swallowed it and came back for another polyp. Curiously enough this rough usage had no effect on the other polyps, which remained expanded as before. The whole of the polyps were ultimately removed in this way. This occurrence does not prove, however, that this fish is in the habit of eating Alcyonarians, and it is to be noted (1) that only one fish of the group acted in this manner, and this particular fish was one which was less able to hold its own, often swimming by itself, and generally did not get a fair share of the usual food; (2) the fish, after seizing the polyp, apparently had some difficulty and hesitation in swallowing it, probably owing to the presence of the spicules; (3) the colony of polyps made no attempt to protect themselves by retracting though they readily did so when disturbed otherwise; (4) the Cavernularia was from deeper water than that frequented by this species of fish, which did not attempt to attack any of the other Alcyonarians in the tank, *e.g.*, *Gorgonia*. The observation is, perhaps, not of so much importance as proving that fish will eat Alcyonarians, but as indicating the reason why they do not habitually do so, in spite of the ap-

parently tempting morsel of a fully-expanded polyp. (Compare with this the eating of sponges by the Dasje, noted on p. 97.)

Bamboo-fish (*Box salpa*).

Among the fish with cutting teeth is the Bamboo-fish, specially adapted for feeding on the finer sea weeds. Its teeth are sharp and lobed on their cutting edges for the tearing up of vegetable matter. They have a long intestine, like most vegetable feeders, and are thus much modified for this particular mode of life. It was remarkable, however, to note how quickly they adopted the habit of the carnivorous fish, when supplied with animal food. Some fish will starve before they discover that food, other than what they were accustomed to, is good. (See observation on Horse-fish.).

The Bamboo-fish is a rather pretty little fish ("Mooinoitje" is one of its names), with bright yellow stripes along its sides (hence another local name "Streepje"). The significance of this colouring was not apparent from any observations made.

Dasje (*Sargus capensis*).

This fish is one which, in its natural habitat, is found in shoals. It is short and high with a somewhat rounded body, so as to suggest in general appearance that of a rabbit or a hyrax (Dasje). Nearly all are distinguished by a large dark patch over the tail, which would appear to be a recognition mark, by which individuals can recognise their own kind, and follow readily the rapid movements of the shoal. An individual may now and then be seen without this mark, and in some it is rather faint.

How sensitive each individual is to the movements of the shoal was repeatedly demonstrated in one of the fish which happened to be blind of one eye. All these fish can be easily attracted to the glass of the tank, and if a sudden movement is made they scatter rapidly in various directions. The fish with the blind eye sometimes happened to be so placed that it could not see the cause of the disturbance, and yet it was observed to dash off almost simultaneously with the others.

Individually, these fish seem rather feeble and harmless creatures, but owing to their persistent nibbling at any likely food, they are factors to be reckoned with in the strenuous life in the sea. More than once it has been observed that even large fish fall a prey to their attacks. They have sharp, cutting teeth, which project well in front of their somewhat acutely-shaped head. Should they discover some wound or weak point

in a fish, they take an occasional nibble in passing, always returning until the victim, which may be a much larger fish, is done to death.

This is the only fish which has been observed eating sponges, and only on one occasion. A large piece of "red bait," incrusted with a white sponge, was put in the tank, and one of the Dasjes began nibbling at it. It tore off a small piece with a sharp jerk, and swam off a little way chewing it. It then ejected the remains from its mouth, and came back for more. It repeated this until little of the sponge was left. That this was not a mere idle or wanton nibbling, which fish in general sometimes indulge in, was evident from the systematic and sustained way in which the operation was carried on. The living tissue was apparently crushed out and swallowed, while the residual horny and silicious skeleton of the sponge was rejected.

Shoals of Dasjes may occasionally be seen among the rocks or out in the open. Their normal food is apparently floating Crustacea, etc., of open water, but chiefly the smaller forms of life growing on the rocks ; it is quite possible, however, that they may make combined attacks on disabled or injured fish in the open sea in the manner described above.

The fish is a typical gregarious fish living in shoals. It has small floating eggs and fertilisation is probably effected, if the generally accepted statement on this point be correct, by the more or less accidental mixing of eggs and spermatozoa shed promiscuously in the water. The same phenomenon observed in other fish was, however, found to occur here, viz., two fish were occasionally seen together, stationary or slowly moving about in a restricted area, darkly coloured, and close to the bottom. Such cases seem to indicate that the process of fertilisation of many pelagic fish eggs may not be such a fortuitous occurrence as is generally supposed.

The Red-Stumpnose (*Chrysophrys gibbiceps*).

While the Dasjes find the food, which they crush between their molars, in very varying localities and circumstances, some of this family of fish specialise in particular directions, and adopt special methods. Of these, one of the most interesting is that adopted by the Red-stumpnose. Like the Dasje and most other fish, they will of course take other kinds of food, which come in their way, but their usual source of food seems to be the molluscs and crustacea which occur in sand. When undisturbed, these fish may frequently be seen in a peculiar attitude. The head is directed downwards and is close to the

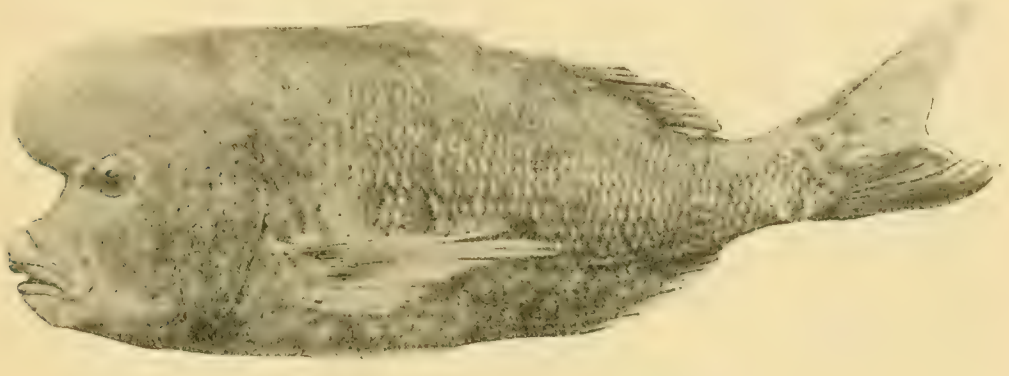
sand, while the tail is directed upwards, the axis of the body being thus nearly perpendicular. In this position the mouth and gill cavity are opened rather widely and filled with water ; then, by a sudden closure, the water is forced out in a jet on to the sand below, with such force as to cause it to fly about and expose any animal life which may be immediately under the surface. (Compare Dumahel's statement that the " Daurade," *Chrysophrys aurata*, stirs up the sand with its tail in its search for molluscs, etc.) A considerable depression may be made in this way. The fish then examines the results closely, occasionally finding something edible. After a time it moves off to another place where it repeats the process till sometimes the whole floor of the tank may be covered with the ringlike depressions so caused. The position of its eyes and shape of its forehead are specially suited for a close scrutiny of the region laid bare by this blowing process ; the forehead is high, the eyes being not far behind the vertical of the mouth and close together, allowing of simultaneous concentration on any object immediately in front. The high forehead and closely-set eyes is characteristic of another fish (noted below), which searches for its prey at close quarters, and the habit may perhaps be associated with such modifications generally.

The Red-stumpnose is of a quiet and retiring disposition, in keeping with this humble and industrious method of obtaining its livelihood, yet it is remarkable for its very vivid colours. These consist of broad bands of bright red colours passing vertically across the body. The bands of alternating red and pale whitish colour may have something to do with the protection of the fish as seen at a distance. In the feeding attitude these appear, of course, as horizontal bands.

So far the habits of the Red-stumpnose had a very obvious meaning, but another phase of its behaviour was somewhat puzzling. On repeated occasions one of these fish, sometimes two together, was observed apparently closely examining Klip-fish(*Clinus*). The Klip-fish were usually lying unconcernedly in a corner or nook in which they were fond of resting. The Red-stumpnose was repeatedly observed intently gazing at a Klip-fish from a distance of about six inches or so. It was apparent from the persistence of this action, the following of the Klip-fish when it moved off, and the twisting about to secure a better view that this behaviour was not accidental. It was at first thought that it was for the purpose of procuring any parasites that might be on the Klip-fish, but none were observed and, although the Stumpnose often approached to within an inch or so of the Klip-fish, it never attempted to seize it or any parasites that might have been present. This

behaviour was very striking, especially when two Stumpnose with their large staring eyes under a high forehead were thus occupied. The Klip-fish apparently were not put out by this attention, but lay perfectly still.

Occasionally a Red-stumpnose was procured in the trawl with an abnormally-protruding forehead, projecting far beyond the eyes. It has been shown in the case of some fresh water fishes that this is due to an accumulation of reserve fatty matter, and this is so in the Red-stumpnose, as shown in the accompanying figure. The fish is known amongst Cape fishermen as the Red-stumpnose, or Rooi Stumpneus. At Knysna



Red Stumpnose (*Chrysophrys gibbiceps*, C. & V.).

it appears to be called the Michael or Michiel for a reason that is not quite obvious. The eggs are small (·88—·82 mm.) and floating.

The White Steenbras (*Pagellus lithognathus, C. & V.*)

This is a fish provided also with crushing teeth, and it appears to find its food in a similar locality to that of the Red-stumpnose, but in a different way, and in mud instead of sand. They have been observed in the same attitude as the Red-stumpnose, the tail directed upwards and the head downwards. In this position they grub round in the mud for what they find, a habit for which the shape of the head region is admirably adapted ; they have long pig-like snouts (at Mossel Bay the fish is called the "Vark-bek," or Pig-mouth), the lips are somewhat protruding and may act as sensory organs. I am told that near Port Elizabeth they are sometimes shot in this position on shallow mud banks. In the aquarium the fish does not exhibit any specially interesting habits, and its main object in life seems to be to procure food. It lives well in captivity though its rate of growth did not appear to be rapid, fish about 7 inches in length increasing to about a foot in three years.

[C.P. 6—'14.]

The Roman (*Chrysophrys cristiceps C. & V.*).

The Dasje may be described as a nibbler, the Red-stumpnose as a blower, and the Steenbras as a grubber. Like these fish, the Roman is also provided with rounded molars behind for crushing its food, but its method of procuring it is entirely different. It has a very capacious mouth, well provided with sharp canine teeth in front, and is of an aggressive disposition. Most of the other fish keep out of its way, and frequently, while they are nibbling or tearing at a rather large piece of food, the Roman will swoop down and carry off the whole in its mouth. It then makes off with haste, followed by the other fish and, although it cannot swallow the large mass of food, will keep it in its mouth till it gets into a quiet corner. It then ejects it and tears it up. The Roman is the only fish which has been observed in the tanks to tackle successfully the hard test of the "Red-bait," and only when some injury, often a small one, has afforded a slight beginning ; it diligently tears at it until the opening is large enough to extract the reddish and soft body of the Ascidian. Most fish, except Dog-fish and a few others, eagerly eat this red-bait when the test is broken.

The Roman is a conspicuously coloured fish with large areas of the body of a bright red, and with a blue thin streak over the forehead between the eyes. No very marked changes were noticed in their tints, and the various regions of the body where they occur are sharply defined and constant. On one occasion some Malay fishermen brought to the aquarium a fish which, while similar to the Roman in every other respect, had the normally red areas of a bright blue colour. The streak between the eyes was as usual. The fish was kept alive in the tanks for about a year and seemed to behave quite normally, except that it did not associate with the other Romans quite as much as usual. The Romans are not, however, very gregarious and there is hardly sufficient evidence to warrant a definite statement on this point which is of interest as bearing on a possible factor in the swamping of such discontinuous variations. No other Roman of a blue or bluish colour has come under observation, and the fishermen said that they had never seen one of this colour before.

The name "Roman" is in all probability an English corruption of the Dutch "Rooi-man" in reference to its red colour. The redundancy "Red Roman" is often heard.

The White-Stumpnose (*Chrysophrys globiceps C. & V.*).

In contrast to its near relative, the Red-stumpnose, this fish is of a sober colour, dark gray or black occurring in vertical

stripes across the body. It is a very common fish in False Bay, and is frequently kept in the tanks of the aquarium, where it thrives well.

It has been noticed that the males are distinguished by the part under the chin being whiter than in the females, a fact which is pretty well established from observation of many hundreds of specimens procured in the trawl.

Vertical striping seems to be a primitive form of colouring, and is very common in the Sparidae. The young of other fish often have it and occasionally it appears for a time in fish which are normally of a uniform colour.

The eggs are pelagic, ·89— ·85 mm. in diameter.

The Dageraad (*Chrysophrys* (*pagrus*) *laticeps*, *C. & V.*).

This fish is occasionally procured in False Bay, seldom or never in Table Bay, though it is abundant a few miles further eastwards, and on the east coast to Natal. It is a gorgeously coloured fish when adult. "Dageraad" means dawn of day, or the Aurora, not Dagger-head, into which it is often translated or corrupted. I have elsewhere suggested that the name is "Dageraad," and credited the donors with a certain amount of poetic imagination, but on further consideration a derivation from "dagge," a dagger, and "graat," a fish-bone, seems more probable, as the fish has a dagger-like first spine in its dorsal fin. In this case the name would be "Dagge-graat," contracted into "Dagraat."

Young specimens were occasionally kept alive in the tanks. The significance of their colouring was not apparent.

The Rock Cod (*Acanthistius sebastoides*, *Cast*).

The perciform fishes are not so well represented on the west and south coast as on the east. They are not at all common in False Bay, but one, called the "Rock Cod," is occasionally got and has been kept alive. It illustrates some interesting features of sea life. It has a rugged spiny head and is generally of a reddish colour. It apparently relies for its safety on its general resemblance to its surroundings and its power of keeping absolutely still. In the tank, when it once takes up a position, usually in a corner, it cannot be induced to budge except by physical contact. No sudden movement or unexpected display, which would alarm, or at least attract the attention of any other fish, will betray it into the slightest movement, even of the eyes. The ordinary food, dropped alongside of it, apparently receives no attention. At first it was difficult to know what to make of this fish, and it was tried

with several kinds of food. It was not till some small crabs were put into the tank that it suddenly awoke to activity. It instantly seized these animals in its capacious mouth, swallowed them rapidly, and almost at once resumed its sphynx-like attitude. Almost all fish, whatever their natural or usual food may be, will after a time take the food offered them, but this fish was never observed to take anything but crabs. It is an example of specialisation in a group of fishes, which usually lead a free life, are powerful swimmers, and are ready to take almost any food. Other kinds of " Rock Cod " (Epinephalus, Serranus, etc.) are readily caught by hook and line with ordinary bait, but this kind seldom.

Paarde-visch or Horse-fish (*Agriopus*, 3 *species*).

The genus *Agriopus* is peculiar to the Southern Hemisphere. At the Cape it is represented by three species—*A. torvus*, *A. spinifer* and *A. verrucosus*. The first is much larger than the others, and is one of the most striking inhabitants of the aquarium. It has a very fierce and forbidding aspect, which the original describer indicates by the specific name " torvus," savage or fierce. It has this same aspect in the tanks and visitors frequently express concern for the safety of smaller fish in its company. Its name and appearance are, however, a libel on its true character. It is one of the quietest and most harmless of fish, as well as the laziest. It swims slowly to and fro in the tank, occasionally resting, sometimes almost on its side, or leaning against a rock. The Klip-fish on occasions find it a soft and convenient resting place, for it is devoid of scales. It sometimes yawns, when its appearance is truly terrifying, the large mane-like dorsal fin with its strong spine being stiffly erected, and its protruding mouth widely opened. It has large, closely-set eyes and a high forehead. Its colour is dark brown, usually with a few longitudinal lateral white bands which sometimes disappear. At other times faint vertical stripes may be seen.

It is not easily startled and takes no interest in other fish, quietly moving off when interfered with. It, however, takes a great interest in small moving things, especially small crabs. If one of these is introduced into the tank it swims up to it with a sort of clumsy haste and proceeds to scrutinise it closely, often twisting its body and head as if making a calculation, all being done very deliberately and with no attempt at concealment or strategy. The next thing observed is the absence of the crab, which has been seized by a sudden protrusion of the mouth of the Horse-fish at a distance of about an inch.

This action is so quick as to be scarcely perceptble. It is accompanied by a rather loud sound, like the drawing of a cork or a rap, which can be heard through the inch-thick glass at any place in the tank-room. This sound is not produced by the teeth of the fish, which are very minute and can scarcely be felt by the finger.

An incident which throws a significant side-light on the habits of the Horse-fish was observed on the introduction of a rather large hermit crab, which a fisherman had found without its shell and brought to the aquarium as an " English Lobster." When placed in the tank the Horse-fish made for it at once ; the crab at the same time recognised an enemy ; it bent its exposed abdominal part quite under the harder carapace and faced the fish, which endeavoured to get behind it. The action of both fish and crab was so prompt and purposeful that it could not but be concluded that they were both familiar with the results of being caught without a shell.

The Horse-fish made no attempt to catch the small fish, which were often around and near it in numbers, but on one occasion it was observed to seize a small cuttle-fish (*Sepia verrucosa*).

Though the Horse-fish will not at first take anything but crabs, like most other fish it soon learns to take the usual food supplied in the tanks—pieces of fish flesh. It was never observed to take " red bait," so greedily seized by most other fish.

Another and smaller species of Horse-fish (*A. spinifer*) is sometimes procured for the tanks. It is, in general shape and appearance, somewhat like the larger form, but has a spine just below and in front of the eyes. The fish, when first procured, was healthy and more lively than *A. torvus*, but gradually fell off, refusing to eat the food offered it. A large piece of " red bait " was put into the tank and it immediately began to show a keen interest in this, peering into the cavities and examining the whole in the same close way as the large Horse-fish. Shortly afterwards it was observed picking out small crustacea and worms and, a few days afterwards, being supplied with this food, it quite recovered its normal appearance and lived for about two years in the tank.

After a time this fish also learned to take pieces of fish flesh, and soon began to watch the keeper for food, as the other fish did.

It is the only fish which has been observed to cast its skin. This occurred in the winter time in July. The process is rather rapid ; thus, in one case, in about three days from the time the shedding began, the skin was observed to be hanging

in pieces from the fish, some of it lying detached on the floor of the tank. The whole of the epidermis of the head, fins, and body was detached ; the new epidermis was of a much brighter colour than the old, a large patch of yellow between the eyes and the beginning of the lateral line being especially conspicuous ; white dots became more conspicuous along the lateral line, and four or five transverse bars of white appeared over the lateral line. The shed skin was examined microscopically, and the epidermal nature was apparent. The scales in this fish are in the form of short needle-like spines firmly embedded in the skin.

The third species (*A. verrucosus*) has never yet been kept alive.

The Barbel (*Galeichthys*, 2 *species*)

These fish, called locally Barbels, Bargers, Baggers, or Barbers, are fairly abundant and live well in captivity. There are two species, *G. feliceps*, the white Barbel, and *G. ater*, the black Barbel. Both have the peculiar habit of carrying their large eggs in their mouths, where they are hatched out and where for a time the young find shelter. As yet no fish with eggs have been observed in the aquarium ; a black Barbel was on one occasion brought to the aquarium with the eggs, which it had ejected from its mouth, but it would not again take them. The white Barbel (it is really of a light brown colour) go up the tidal rivers near their junction with the fresh water and on one occasion, when about 2,000 of these fish were caught in a net at the Zwartkops River near the fresh water part (it is tidal for several miles), all were observed to have from twenty to thirty eggs in their capacious mouths. Of the specimens dissected (about twenty), all were males. Some had young fish, others eggs in their mouths. The anglers stated that they sometimes caught these fish by hook and bait with eggs and young fish in their mouths, so that the habit would not seem to interfere seriously with feeding.

The adults invariably kept in dark nooks and corners gently swaying their bodies and fins, but towards evening and at night they were very active, roaming over the whole of the tank. The young, however, were equally busy during the daytime. They do not appear to use their eyes at all, although these organs are fairly large. Their sense of smell, however, is keen and, when food is put near them, they become greatly agitated and search diligently about, their long feelers touching the ground. They often pass within a few inches of the food, apparently without seeing it, but, if the tips of one of their feelers touch it, they turn on it eagerly.

They are provided with strong spines in their dorsal and pectoral fins, and an interesting illustration of the advantage of such weapons was observed in the tanks. The " Dik-kops " (*Gobius* of various species) are abundant, and several are generally present in the tanks of the aquarium, where they thrive very well. They are little fish with rather wide mouths, always on the alert and ready to seize anything likely to be edible. On one occasion a young Barbel, about three inches long, was put into the tank, and immediately began investigating its new surroundings, trailing its long feelers over the bottom ; the new arrival attracted the attention of a large Dik-kop (*G. nudiceps*), which, after a somewhat prolonged consideration, suddenly made a dash at the stranger and succeeded in seizing it bodily in its large mouth. It as quickly ejected it, however, and rushed about the tank shaking its head violently, evidently much upset, while the small Barbel proceeded unconcernedly with its investigations as if nothing had happened, its strong spines, which can be stiffly erected, no doubt having served it in good stead in this emergency. It was not again interfered with.

Fishermen sometimes get painful wounds by the incautious handling of the fish. Though there does not appear to be any definite poison secreted, the wounded part often becomes inflamed and causes great pain.

The Harder or Mullet (*Mugil capito*).

This fish is well known. Unlike the previous fish, it is more of a pelagic habit. Its laterally placed eyes and elongate form are probably adaptions for such a life. Fishermen observe that it has some peculiar habits especially with regard to its movement in shoals

One peculiarity observed in the case of young Harders in the tanks may be mentioned. They are usually timid fish, and are easily startled by any unusual occurrence or the presence of a Klip-fish. Towards evening, however, in the tank they sometimes showed a rather playful behaviour, and indulged in what appears like a sort of game. After some gambols, or at least rapid spasmodic movements of the shoal, one fish may be observed in an almost vertical position in mid water with head down and tail almost vertical. It keeps up a peculiar quivering of the fins, especially of the caudal. It is soon followed by the others one by one till the whole shoal is grouped together in a small space, each fish behaving in this peculiar manner. Suddenly the fish, as if at some given signal, disperse wildly in various directions, afterwards resuming their gambols in a shoal. The vertical position is

again taken up and the whole process is repeated several times. This was the only evidence of playfulness observed in any of the fish.

Healthy fish generally keep the surface of their body scrupulously clean and sometimes effect this by rubbing on rocks or on the sand. Klip-fish, for instance, may be frequently seen progressing along the bottom of the tanks by what appears a series of somersaults, evidently for this purpose. The Harders in the tank seldom came to the bottom, and they found rubbing posts on the spines of the dorsal fins of their fellows. Thus one of a group of Harders was occasionally seen dashing about in the shoal skimming over the backs of the other fish to their evident discomfort. As it passed over their broad dorsal spines it turned on its side, which was then dragged quickly over their hard edges. A peculiar habit of the South African mullets (*Mugil constantiæ*, the "springer") may be mentioned here. It is found chiefly in the rivers, and, in many parts of Cape Colony and Natal, it is the custom to catch this fish by going out at night with a light in the boat. The fish jump into the boat of their own accord—one of the simplest and easiest methods of fishing known.

The Maasbanker (*Trachurus trachurus*, Lacep).

These fish, apparently identical with the "Horse-mackerel" of Europe, were occasionally kept alive in the tanks. Small specimens, about three or four inches in length, did fairly well in captivity. They are lively little fish and generally get their fair share of food, and that by a peculiar device. As is well known, they have a row of large scales along each side of the tail, and these are provided with sharp spines so as to form a rasp-like organ. The Dasjes also are always in evidence when there is any food about, and the curious spectacle was sometimes seen of these small fish driving off the larger Dasjes by a very quick movement, somewhat similar to that noted above in the case of the Harders, the sharp spiny scales being drawn rapidly over the side of the Dasje, which at once fled and, although it made several cautious attempts to approach the food, was as often driven off. Ultimately it made off promptly whenever the Maasbanker approached the neighbourhood.

The young of this fish are said to seek shelter under the tentacles of Medusae.

Klip-zuiger or Sucker-fish (*Chorisochismus dentex*, Pall.).

The habits of this fish are peculiar and recall those of the Remora. Its one object seems to be to fasten on to some

more or less flat surface by means of a very large sucker on its ventral surface. This sucker is formed of the very much modified ventral fins, and is a most effective means of attachment, as it is about as broad as the fish itself. The fish was never seen to eat, and very rarely moved from the one spot. It could not be startled by any sudden motion, not even moving its eyes. When forcibly removed from the rock it swam off a short distance with a somewhat clumsy haste and fixed itself again not far off. Its behaviour in rock pools is somewhat different. If suddenly surprised it scurries off a few feet, generally hiding under a stone, from which it can, however easily be taken by hand.

The most of the observations on this fish were thus of purely negative character, but on one occasion a specimen, which was found making its way up into very shallow water, was put into the tank, and seemed to throw some light on this peculiar habit. About two days after its introduction into the tank it deposited a number of eggs in a single layer over a flat stone, and apparently kept guard over them by covering or partly covering them with the large sucker, the lower part of the broad and rounded ventral fin often keeping up a baling-like movement. The eggs were small, circular, and contained a number of oil globules. They were examined from time to time, but no development took place, apparently not having been fertilised. The fish did not take any special care of the eggs, except to cover them in this way, and soon seemed to lose all interest in them. Other fish, chiefly the Dasjes and Klip-fish, began to pick them off one by one, and a large Star-fish endeavoured to reach them. They were then protected by a piece of wire netting, but no development took place, and they soon disappeared. It may be that the development of the enormous sucker is connected with the protection of the eggs.

Lootsman, Sucker (*Echeneis remora*, Linn.).

This, as is well known, is also a sucker fish, the dorsal fin being modified into a large sucking disk over its head. On one occasion a fisherman brought three specimens of this fish, which he had found firmly attached to a shark caught in a seine net. They adhered firmly to the bucket of water in which they were brought, and could only be dislodged by inserting something under the edge of the sucker, thus admitting the water. They then suddenly relaxed their hold, but immediately attached themselves close by to another part of the bucket. Eventually, however, they came out of

the bucket, which was held in the water, and became attached to the sides or to the glass front of the tank. The two largest were, respectively, $7\frac{1}{2}$ and 9 inches in length, coloured black or dark grey dorsally, and lighter ventrally. The third specimen was much smaller, being about 4 inches in length and much lighter in colour. It was found attached to the roof of the mouth, while the other two were attached externally to the ventral surface of the shark. Their hold is very secure, and they could not be pushed away without risk of injury. If, however, the finger nail be inserted under the edge of the sucker, they suddenly release their hold, and in an apparently indiscriminate way at once attach themselves to the nearest object. One of them happened to attach itself to the glass of the tank so that its mouth projected above the surface of the water. It remained in this position, though apparently in distress, until it was forcibly removed. It was noted that they never, like other fish when first put into the tank, unintentionally knocked their heads against the transparent glass, but attached themselves to it at once. The turning movement, which is necessary to attach the sucker, which is on the top of their head, to an object in front of the fish, was performed so rapidly that the details could not be followed by the eye of the observer.

The other fish in the tank took very little notice of the suckers, though they usually make a thorough inspection of every stranger. One large Klip-fish, however, hovered around one of the attached fish, and finally made a snap at its tail, but immediately went off and paid no further attention to it.

When first put into the tank, the sucker-fish remained in the same position for about half an hour, when one went off and attached itself to another part of the glass. Shortly afterwards the largest left the glass, and swam about rather rapidly at the surface of the water. Its method of swimming is worthy of note. It progressed by a continuous undulating motion of the whole body, occasionally making sudden darts as if at objects on the surface of the water. During the whole time it was swimming, the mouth was carried along the surface or slightly under it, the posterior end of the body being rather deeply submerged in the water. This position was maintained by the use of the pectoral fins, which were constantly held in a rigid position, and at such an angle as to raise the anterior part of the body when in motion. The dorsal, anal and caudal fins were used as organs of locomotion, undulating with the whole body. The ventrals, however, were used in a totally different way. When the fish moved forward they were closely appressed to the body. Progress could however be quickly arrested by the sudden erection of both of those fins, or a

change in direction of motion to one side could be effected by the sudden erection of the fin on that side while the other was kept close to the body. A sudden change in direction is of course in ordinary fishes more usually brought about by a flexure of the tail or the whole body. The probable meaning of the habitual use of this peculiar method of steering was made apparent when the fish was swimming in circles, which it often did. The tail was then used only for propulsion, while the ventral fin on the one side kept the course to a circle, being held continuously erected. This habit may be connected with its peculiar mode of life in association with the shark, for there is some danger of its being left behind, should it wander too far off.

These fish often attach themselves to ships and large fish, like sharks and whales, and sometimes to turtles. Natives on the east coast of Africa, as is well known, catch the last-named animal by the curious fishing tackle of a live Remora on a string. The fish will fasten on and keep its hold with the unreasoning obstinacy of this peculiar instinct

The Blaasop (*Tetrodon honckenii*, Bl.).

The general behaviour of this fish differs markedly from that of any other observed ; in this respect and in its rather bizarre appearance, it offers a striking contrast to the other inhabitants of the tank. It usually swims about quite unconcernedly, apparently without fear of attack. Fish usually owe their power of locomotion to the use of the powerful muscles of the tail, and by a single powerful stroke are able to project the body through the water at a very rapid rate. Even fish which usually move comparatively slowly can in this way escape danger. The Blaasop, however, except on rare occasions, was observed to use only its fins, the dorsal, ventral and pectoral for locomotion, in a sort of sculling or paddling manner. The fish can therefore by these same means preserve its balance, and the absence of pelvic fins, which are generally used for this purpose in other fishes may thus be accounted for. The muscles of the tail are not well developed, and this organ with the rather elongate caudal fin is used as a steering organ, seldom as a locomotory organ. When it occasionally hurries along at an increased speed for food, the fins used in progression merely flicker to and fro more rapidly. It rarely darts about, but proceeds at a more or less uniform rate in a deliberate manner. Nor is it protected by colour, being, on the contrary, rendered rather conspicuous by large yellow spots scattered over the surface of the body. The head is large

and the eyes, which are of a peculiar reddish colour, as if blood-shot, are situated high in the head, giving the animal a sort of resemblance to a toad—it is indeed often called the Toad-fish. The mouth is provided with hard fused beak-like teeth and is placed at the upper anterior corner of the head, the lower jaw forming a very large chin. It lives on barnacles and shell fish, which it nibbles from the rocks.

Many fish of the family (*Tetrodontidæ*), to which it belongs, are well provided with defensive organs in the shape of numerous strong spines, which can be erected by taking in water into a large sac on the digestive tract, when the fish becomes inflated into a round ball. This fish can also do this, but the spines are comparatively feeble, and apparently quite inadequate as defensive organs. Nor is the animal protected by its ferocity; it was never observed to attack any other fish or large animal in the tank, and its slow paddling system of locomotion and its general structure of mouth, teeth, etc., are not at all adapted to such purposes.

The secret of its immunity from attack, and perhaps its conspicuous colouring, is at once evident if pieces of the flesh of this fish be offered to fish and other animals in the tanks. As when the flesh of ordinary fish, crustacea, etc., is thrown into the tanks, there is a rush of all the fish to secure a piece; the food is torn up and scattered about, individual fish making off to quiet corners to devour what they have happened to secure. No fish, however, in this case eats what it has been so anxious to procure. One by one they drop the pieces, often apparently with reluctance, as they continue for a while to return to them; finally, however, they take no further interest in the proffered food, even avoiding its proximity.

The flesh of the Blaasop is therefore distasteful to other fish and it is to this fact that the fish probably owes its immunity. The conspicuous colouring of the body is, doubtless, a case of warning colours or danger signals, useful both to the fish and its would-be enemies.

It is a well-known fact that the flesh of the Blaasop when eaten by land animals has proved to be poisonous, the liver being especially so. Fatal cases of poisoning have occurred by the eating of this fish by seamen on ships visiting Simon's Town, where it is abundant, and the native fishermen are well aware of the serious results which follow the eating of its flesh. They say that even if the liver touches food, it renders it poisonous. Many of these fish are caught in the seines, and their dead bodies may be always seen lying about on the beach, and fishermen say that if any of these decaying fish be handled the skin of the hand begins to itch and breaks out in red spots.

This was not confirmed on experiment, but a small piece of liver given to a guinea pig caused death in a few minutes. Undesirable cats are often got rid of by offering them this fish, which they take readily.

It is to be noted that not only do the fish instinctively avoid the Blaasop as it swims about, but even the taste of the flesh seems to give sufficient warning of its dangerous character. All the animals in the tank did not however behave in the same way in this respect. Thus when a dead Blaasop was thrown into the Octopus tank, this animal took it at once, enveloping it quickly in its arms, but shortly afterwards rejected it. On another occasion, however, a live Blaasop was seized by an Octopus and retained. The fish became much distended till it was almost spherical, but still the Octopus did not relax its hold. It was kept under observation from about four in the afternoon till late at night, but the fish was still retained, and next day the Blaasop or what remained of it, was found on the bottom of the tank. The Octopus had apparently eaten all the fish except the skin, but, on further search in the tank, the whole of the liver was found floating on the surface of the water. The Octopus seemed none the worse for its meal, and readily took crabs offered to it immediately afterwards. The liver was offered to some very small and presumably inexperienced Harders (2 to 3 inches long) ; they eagerly crowded round it, then hurriedly went off ; only one out of the thirty ventured to nibble at it, but it also immediately left, and subsequently none approached it. Perhaps in this case the smell was sufficient warning.

The liver was then given to a large sea anemone, and this animal not only took it as readily as any other food, but very soon enveloped the whole of the relatively large mass in its interior, closing its mouth over it particularly firmly. The liver was retained all day, but on the following morning a white mass was found on the surface of the water, and this, on examination, proved to be the liver enveloped in a white emulsion as if the process of digestion had commenced. The anemone apparently suffered no ill effects from the experiment.

A number of Dog-fish (*Scyllium africanum*, Gm.) are usually kept in the tank. They thrive very well and many have been kept alive for several years. During the daytime they lie about quietly with their eyes closed, waking up at night, when they swim about freely with open eyes. If a piece of fish or an injured fish be put into the tank they, however, arouse themselves, and go hunting about, guided by smell alone. On one occasion an injured Blaasop, put into the tank, was caught by one of the Dogfish in this way. Whether this would have

happened in the dusk or semi-darkness when the Dogfish had its eyes open is uncertain, but on this occasion it swallowed the Blaasop whole, without any hesitation, and then returned to a quiet corner, as Dogfish do after a heavy meal. After a considerable time it seemed uneasy, and finally became very sick, ejecting half-digested fragments of Blaasop from time to time. No serious results followed, however, and next day the Dogfish was quite normal. On one occasion a large Starfish (*Asterias*) got hold of a piece of Blaasop liver, and took it quite readily, folding it in its arms, and enveloping it in the fine membranes of its stomach. It held it thus from an afternoon till the following morning, when most of the liver had disappeared. The remainder was taken possession of by another Starfish, and finally none was left. The Starfish seemed none the worse for their meal. It cannot be concluded from this single instance, however, that the Starfish actually took the poison into their system, as much of the brown substance of the liver became somewhat flocculent and floated away. The connective and some other tissues, however, were apparently digested.*

With regard to the peculiar habit of distending the body (hence the name Blaasop), this may be defensive, as shown in the case above mentioned. When drawn up on shore with the seine net, the fish inflate themselves with air, especially if irritated. No artificial irritation was found to produce the inflation in the water and, only on one other occasion, was a Blaasop observed to become distended in this way. It had been several months in the tank, and once it was found to be so distended that the body was about spherical. A few minutes after this was observed, it suddenly assumed its normal size. No air bubbles were seen escaping. The accepted explanation of the inflation of these fishes is that when alarmed it distends itself with air taken in at the surface of the water. It then floats, belly upwards, and is thus protected from its enemies. This may be true of other species of globe-fish, but in the case of the Blaasop the distension with air seems to occur only when the fish is removed from the water.

A species closely allied to the Cape 10rm occurs in Durban Harbour. It makes off rapidly when surprised and if chased for a short distance in the shallow water, in which it usually occurs, it buries itself in the sand, and when lifted up becomes greatly distended.

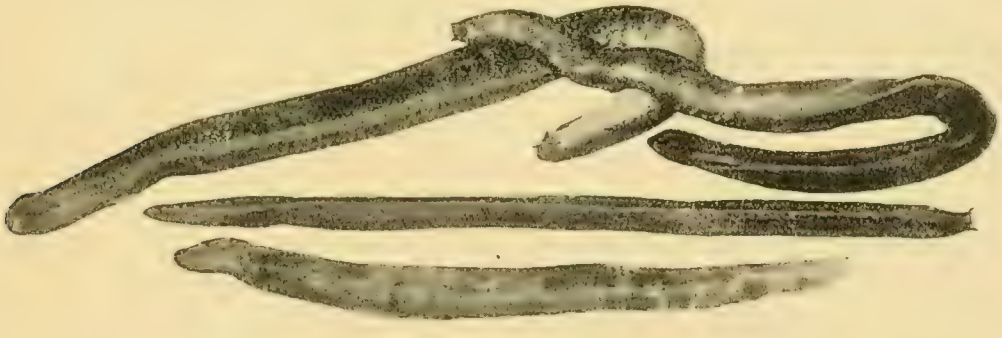
* For a detailed account of the poison found in the tissue (chiefly the genital organs) of the Tetrodontidæ, see "Uber die giftigen Bestandteile des Tetrodon," Zeitsch. d. med. Ges. in Tokio 8, Heft 14.

Still another possible significance of the blowing-up process may be indicated by an occurrence, the facts of which I obtained from the observer. The "Leguaan," a large crocodile-like lizard, is abundant in the rivers of the east coast, and on one occasion one of these was found recently dead, having been apparently choked in endeavouring to swallow a Blaasop, which was found in an inflated condition, completely stopping up the throat. Various species of Blaasop are specially abundant in the lagoons and tidal rivers, in which the Leguaan also occurs.

A peculiar action was observed in nearly all specimens of this fish when first introduced into the tank. One tank is lined with white tiles and the fish persisted in pressing their prominent chin against this surface, paddling meanwhile energetically with their fins as if to force their way through the tiles. This action was kept up for days until the skin of their chin was rubbed through producing a large open wound. They occasionally rubbed in the same way against the glass front of the tank. No explanation of this was apparent. Their behaviour otherwise was quite normal and they took food readily.

Zee-slang (*Heptatretus hexatrema*, Müll.).

This fish occurs abundantly in Table Bay and False Bay, and many specimens have been kept alive. Usually they do not thrive very well in the tanks. One specimen, however,



"Sea Snakes" (*Heptatretus hexatrema*, Müll.)

which found a hole in the rockwork of the tank, lived and throve well for over two years, till it grew too big for the hole. During this time an opportunity was afforded of observing its habits to some extent. It, however, only came out at night, and usually lay with only the tip of its snout or tail projecting from the hole during the day. It is well known among fishermen that other fish avoid the Zee-slang, and even the mucus which is freely given off from the surface of its body, so that a

hook and line, on which it has been caught, cannot be used with success to catch other fish. It was, therefore of special interest to note its habits in captivity. Only one fish was observed to attack it—a Klip-fish, which snapped once and only once at its protruding tail.

Sometimes during the day, if a piece of fish flesh was placed before the head of the fish, its method of feeding might be observed. It occasionally drew the food into the hole, but often consumed it without scarcely moving it from the place on which it lay, a fact which may explain the mysterious disappearance of bait on a hook without any indication to the fisherman of a "bite."

It is well known that when the fish is irritated or startled it gives off large quantities of a mucus-like substance consisting of very fine long threads, which normally lie coiled up in the skin of the fish. This was readily observed, though the only occasion on which it was seen to do so naturally, was when it accidentally touched the tentacles of a sea anemone with its projecting feelers.

The secretion of this mucus would thus seem to be a method of defence, but there is reason to believe that it may serve another purpose. On examining the tank in the morning, pieces of the mucus were often seen on the rockwork or on small stones. Some of these might have been occasioned by the irritation of contact with an anemone as above noted, but many pieces were found, where this could not have been possible, for instance, on the branches of a large "red coral" (*Gorgonia flammea*), which was suspended in the tank, and among the branches of which the mucus sometimes appeared like the web of a spider. When examined microscopically, it was found that many minute forms of animal life had become entangled in the coils of its innumerable threads. These were chiefly small Crustacea, Protozoa, etc., and several Trematodes were observed securely caught by a loop of the fine thread round their sucker. Once or twice some of the fishes (Klip-fish and Dasjes) were seen endeavouring to tear up this mass, and though they dragged it about a little, it seemed to cause great inconvenience by adhering to their teeth so that they had some difficulty in shaking it off. In no case were they observed to devour it. The only animals that were seen to eat this no doubt nutricious mass were the Anemones and occasionally one of these animals was observed with its gullet widely protruded and closely applied to one end of the substance, which was gradually drawn into the Anemone's stomach.

Many of the pieces were, however, in such a position that they could not be secured by the Anemones, and these invariably

disappeared before the following day or at most two days afterwards. This may be a method by which the animal procures food by the special device of this mass of thread-like mucus, which, after spreading over various places, it afterwards devours with whatever may be captured in its meshes. The fish was watched carefully, but it was never seen to take this or any other food during the night time, though it apparently must have done so, as it came out then and searched diligently through the tank. The little that it got in the above instances during the day could hardly have kept it alive for over two years.

[C.P. 6—'14.]

VI.—THE SNOEK AND ALLIED FISHES IN SOUTH AFRICA.

In Europe the fish of chief commercial value belong to the families of the Gadidae, Clupeidae, Scombridae, Pleuronectidae (Cod, Herring, Mackerel and Flat-fish). At the Cape of Good Hope the Trichiuridae, Pristipomatidae, and Sparidae (Snoek, Silver-fish, Stumpnose) are among the most important, and to these may be now added, since the introduction of trawlers, the Pleuronectidae (Soles). The Snoek family is of little or no importance in the Northern Hemisphere, but in the Southern —in South America, South Africa, Australia, New Zealand and Tasmania—one of its members, called the "Snoek" at the Cape, "Barracouta" in Australia, and "Sierra" in Chile, is one of the chief mainstays of the fishing industry. This is specially the case in South African fisheries, in which the fish forms the greater part of the export trade.

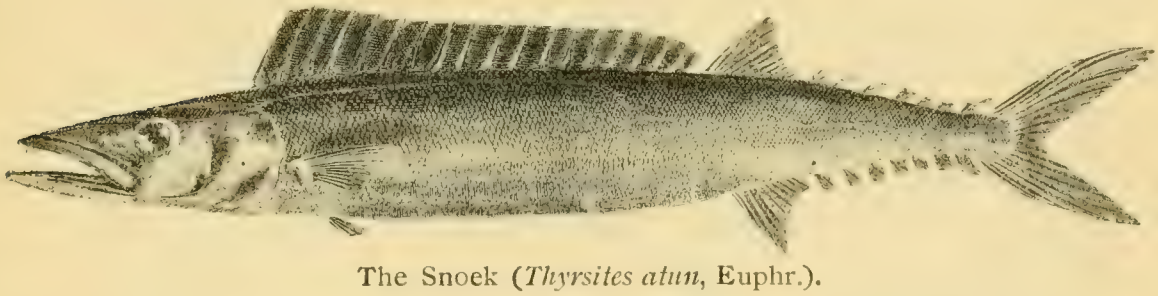
The Snoek (*Thyrsites atun*, Euphr.).

Difficulties have from time to time arisen with regard to the Snoek fishery, such as the diminution of the supply, the desirability of a close season and of a size limit. Doubts have even been raised as to whether the small Snoek protected by legislation is not a different species from the large Snoek, and many of these small forms have been captured on the supposition or under the pretext that this is so. Again the diminution of the supply has been alleged to be due to the destruction of the "spawn" of the fish, which at some places (St. Helena Bay) is said to occur as sheets of gelatinous matter on the surface of the sea, and others (Kalk Bay, etc.) as minute particles of a reddish colour. The following notes will throw light on some of these difficulties.

Among the early entries in Van Riebeek's Journals we find one—"caught a sea-pike," or in his own words a "Zee-snoek," Snoek being the word used in Holland to designate the fresh-water fish the Pike (*Esox lucius*), which is so abundant in that country. It was not a Pike nor did it resemble it closely, not even belonging to the same family; one obvious difference, apart from more fundamental divergencies, being its very long dorsal fin, extending along the whole length of the body, whereas in the Pike this fin is confined to the tail region. It

did not, however, resemble any other well-known fish in Holland, and its rather long, flat body, its pointed snout, and the fact that the long spiny dorsal fin usually lies concealed in a a groove, doubtless suggested the name given it by the early Dutch sailors ; a name which in the mind of South Africans has become so identified with the Cape fish that they are somewhat puzzled when visiting Holland to find fish laid out on the market slabs as " Snoek," so totally different from the one they know under that name. Even in some Cape official volumes van Riebeek's " Zee-snoek " is translated " Sea-snoek." Kolben at a later date mentions the occurrence of the " Pike " at the Cape, and states that it is here not a fresh water but a sea fish. Otherwise he says it is identical with the European fish.

Specimens of the fish were subsequently (about 1791) sent to Holland for examination, and were declared by Euphrasen, a distinguished Dutch zoologist, to be a species of Mackerel (*Scomber*), which he named *Scomber atun.*



The Snoek (*Thyrsites atun*, Euphr.).

The Snoek was afterwards re-discovered (1802) and named by the naturalist Bory Saint Vincent in his " Voyage aux quatre îles des mers d'Afrique " " Acinacé batarde," as he thought it showed relationship both with the Mackerels and Swordfishes.

With the expansion of geographical knowledge it was found that the same fish occurred in New Zealand, and as far from this region as the coast of Chile.

Specimens were afterwards sent to France from the Cape, and a further examination (1831) proved that it belonged to a distinct genus, and was to be classified along with a rather rare European fish, the Scabbard-fish (*Lepidopus*), and not with the Mackerels. This family of fishes (the Trichiuridæ) are inhabitants of the great oceans, and are strong swimmers, as might be expected from their long flat body with few or no scales. They are among the pirates of the high seas, and most of them are armed with a formidable array of large sharp teeth. The dorsal fin is very long and behind it, as in the Snoek, there are often finlets or small detached fins which may act as accessory

steering organs. The head and teeth resemble those of the Barracoutas (*Sphyraenidæ*), from which, however, they may at once be distinguished by the continuous dorsal fin, which in the Barracouta is divided into two small fins far apart from each other. The elongate body, however, though more compressed, is a point of resemblance to the Barracouta, and the early settlers in New Zealand gave it this name, by which it is still known there, as well as in Tasmania and Australia, where it was subsequently found. It is interesting to note, as throwing a sidelight on prehistoric conditions, that, whilst the aboriginals of South Africa do not seem to have caught the fish, nor even to have had a name for it, the Maoris of New Zealand—who called it the Manga or Maka—used it extensively. It provided the sole fish supply of the early Otago settlers.

The Snoek is so familiar to South Africans that a description may seem superfluous ; but such are the vagaries of popular nomenclature that at Natal, where the fish does not occur, another and entirely different fish is known under this name, viz.. *Cybium commersonii* belonging to the Mackerel family and known in Australia as the Giant Mackerel or King-fish.

The body of the Snoek is long (about 8 times its height) and of a dark metallic colour. Its dorsal fin consists of 20 sharp spines, which can be folded in a groove so that they are not seen ; this is continued into a rather short non-spinous part which is not depressible. Behind this soft dorsal there are small separate finlets, six in number. The tail fin is distinct and separate from the dorsal. Not only are the jaws provided with strong teeth, but the palate also. The scales are minute

The Snoek, as might be supposed from its general appearance, is capable of rapid and sustained motion, and is a migratory fish, appearing and disappearing at more or less definite intervals during the year. In former years, when Snoek were very abundant, the fishermen were " signed on " for 8 months from the 17th of September in each year, for the " poor Snoek " season. The " poor " or lean Snoek were so called because they had little or no fat, though the ovaries were well developed only in these kinds ; this " poor Snoek " season lasted until December, when a few fat Snoek began to be caught among them. The fat Snoek season lasted from January to June, during which period they were caught in immense numbers ; about the beginning of July the difference in condition and abundance became very marked. This annual movement of the Snoek is generally supposed to be connected with that of the " Sardine " (*Clupea sagax*), on which they largely feed ; the appearance of these small fish on the coast is regarded as a sign that Snoek will soon turn up, and the latter are usually

in good condition as long as the Sardines remain. The worst time of the year for Snoek is from about the middle of July to the middle of September, and during this period very little fishing is done.

Besides seasonal variations, Snoek seem very sensitive to changes of physical conditions. Thus it is stated that on a heavy wind springing up they disappear ; they lie at the bottom and will not rise until it is calm again. In stormy weather they have been seen at some depth, with head pointed steadily downwards and tail gently waving ; but it is also averred that should strong N.W. winds blow while they are in False Bay they leave that locality and re-appear in Table Bay. The day after an unusually successful catch in False Bay, a strong wind sprang up from the N.W. (off-shore), and although all the boats went out, not a single Snoek was to be found. There are, therefore, seasonal variations in the appearing of Snoek, connected probably with the movements of the "Sardine." which in its turn probably moves inshore at certain seasons for spawning or other purposes ; there are also variations from day to day connected apparently with wind and weather.

But there are in addition certain peculiar appearances and disappearances extending over much longer intervals. Unfortunately, no statistics are available for an accurate enquiry into this matter, and all sorts of explanations are given for the "disappearance of the Snoek"—the increased number of steamers calling at the Cape, the unchecked increase of seals, the running of trains, the operations of the Government experimental trawler and of the North Sea trawlers that followed in its wake, and so on. The scarcity of the fish was accomapnied by its irregular appearances, the fat Snoek appearing more or less late in the season ; and the fish appeared to be restricted more to the colder water of the west coast, never being found to the same extent as formerly on the south coast. At Mossel Bay, for instance, the Snoek were in former times caught in quantities, but since the "disappearance" they have not been at all abundant. The cause of the falling-off of the supply was much discussed, and so serious was the matter considered to be that a regulation was issued by Government forbidding the capture of any Snoek under 24 inches in length. After 15 years of falling-off, the Snoek again suddenly appeared in great numbers in 1907 and 1908, and in the former year they were got even so far to the east as Port Elizabeth. It appeared as if the early years of plenty were again returning for the Snoek fishery, when these fish were sold, it is said, at a penny each. On some occasions they were actually sold at this price during these two years. During the

year 1908 the fish seem to have been off Cape Point the whole year.

For some years previous to 1902 the Snoek had been very scarce, and in that year (the worst on record) enquiries were made by the Cape Government in order to ascertain if the falling off was of local occurrence. Information was received from Australia (Melbourne) that during the year in question "the fish had been exceptionally plentiful, a good supply being on the market about daily from January or February last up to the present time and are still plentiful (3rd November, 1902); nor had any falling-off been observed in Tasmania or on the Chilian coast of South America, where the fish also occur.

The following tables are drawn up from the statistics formerly procured from various fishing stations by the Cape Government and indicate the fluctuations throughout the years 1897–1904:—

NUMBER OF SNOEK caught at various Fishing Stations for the various Months of the Years 1897–1904.

1897.

Locality.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	3,212	6,436	2,851	9,344	10,624	30	..	..	..	2,807	12	30	35,348
Steenberg Cove	4,240	1,100	7,072	15,754	26,754	1,811	..	..	1,668	1,190	..	29	59,618
Stompneus and Britannia Bay	11,693	3,101	28,566	40,695	69,261	9,479	..	..	1,109	1,570	..	179	165,653
Paternoster ..	2,568	1,642	8,425	19,526	48,379	8,084	..	3,279	11,945	208	..	..	104,060
Langebaan ..	..	..	..	..	2,367	1,133	..	..	..	..	..	..	3,500
Kalk Bay ..	..	930	245	2,643	..	..	..	..	..	5	64	..	3,887
Simon's Town ..	..	110	106	36	..	..	..	2	14	..	200	..	468
Somerset West..	..	..	..	..	21	17	103	158	23	75	..	..	397
Hermanuspetrus-fontein ..	58	291	12	18	314	18,867	2,249	117	228	3	39,400	4	61,561
Mossel Bay ..	..	..	..	..	..	..	2,000	140	..	..	..	..	2,140
Knysna Heads..	..	..	..	..	1	7	9	..	1	..	..	..	18
Buffalo Bay ..	..	..	..	..	..	..	2	..	..	..	..	..	2
Plettenberg Bay	..	..	..	..	..	12	62	..	1	..	..	..	75
Total ..	21,771	13,610	47,287	88,016	157,723	39,440	4,425	3,696	14,988	5,858	39,676	242	436,733

1898.

Locality.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	1,457	572	2,354	10,677	3,548	75	..	..	1,036	12,704	4,229	5,153	41,805
Steenberg Cove	300	1,754	18,631	16,630	6,283	641	..	..	353	846	1,556	14,309	61,303
Stompneus and Britannia Bay	1,011	5,513	44,458	30,505	11,728	3,384	..	..	402	1,773	5,568	20,918	25,360
Paternoster ..	684	17,433	9,757	20,293	12,626	8,997	..	2,644	2,296	1,498	513	18,772	95,513
Langebaan ..	..	..	..	144	485	307	..	..	..	..	..	..	936
Simon's Town ..	..	..	..	..	..	..	..	..	3	..	..	..	3
Kalk Bay ..	..	..	..	93	..	..	..	..	..	..	..	..	93
Somerset Strand	..	6	..	8	180	29	..	19	4	1	..	..	247
Hermanuspetrus-fontein ..	18	90	73	13	19	214	719	509	59	122	28	3	1,867
Mossel Bay ..	..	..	..	..	..	..	36	34	14	..	..	..	84
Knysna Heads	1	..	..	..	1	2	61	130	7	..	250	..	202
Buffalo Bay ..	101	..	..	80	..	..	233	117	1	..	..	..	782
Plettenberg Bay	..	..	..	..	..	..	11	..	..	..	..	..	11
Algoa Bay ..	..	..	..	..	..	..	..	..	..	..	..	*230	230
Total ..	3,572	25,368	75,273	28,443	34,870	13,649	1,060	3,453	4,175	16,944	12,144	59,485	328,436

* There is some doubt as to the accuracy of this return.

1899.

Locality	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	1,599	2,643	7,726	18,836	3,916	9	..	..	54	252	2,237	795	38,067
Steenberg Cove	4,590	3,427	11,216	23,965	30,358	4,081	..	..	2,454	623	1,020	1,886	83,600
Stompneus and Britannia Bay	10,961	8,028	22,489	52,168	63,583	12,584	..	..	547	1,627	1,307	4,083	177,377
Paternoster ..	3,882	13,337	27,105	22,729	20,697	4,666	..	..	..	..	98	1,313	93,827
Langebaan ..	..	177	1,668	2,667	3,820	1,464	..	..	..	..	..	..	9,796
Simon's Town ..	..	3	..	..	..	5	..	..	..	..	..	..	8
Somerset Strand	..	1	1	..	12	1,538	1	2	10	..	17	..	1,582
Hermanuspetrus-fontein ..	..	..	..	..	..	420	..	..	125	..	..	..	545
Struis Bay ..	..	..	..	..	..	..	3	..	..	..	..	..	3
Mossel Bay ..	..	..	..	..	..	41	..	..	..	40	..	..	81
Kysna Heads ..	..	..	..	..	..	1	6	7	2	..	..	98	114
Buffalo Bay ..	..	..	..	..	..	3	2	1	..	..	..	..	6
Plettenberg Bay	..	..	..	..	7	19	2	67	2	31	..	..	128
Total ..	21,012	27,616	70,205	120,365	122,393	24,831	15	77	3,194	2,573	4,679	8,175	405,135

1900.

Locality.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	127	1,763	3,978	6,291	3,595	477	..	..	4	5	2	813	17,055
Steenberg Cove	28	431	155	41	4,361	654	..	..	..	..	11	..	5,681
Stompneus and Britannia Bay	245	1,880	767	552	11,335	1,775	..	..	..	3	57	3	16,617
Paternoster ..	303	292	416	1,187	3,225	1,402	..	5	..	..	..	..	6,830
Hoetjes Bay ..	..	176	1,103	1,611	6,311	847	..	60	410	..	..	..	10,518
Langebaan ..	52	34	22	..	414	443	..	..	..	..	..	..	965
Cape Town ..	..	..	..	..	..	30,380	350	40	..	..	10,900	..	41,670
Simon's Town ..	..	..	..	..	..	..	..	..	12	..	..	..	12
Kalk Bay ..	..	..	..	..	..	5	..	2	12	..	..	..	19
Somerset Strand	..	..	..	1	3	2	2	..	6	2	..	..	16
Hermanuspetrus-fontein ..	..	..	..	..	150	..	..	180	437	75	40	..	882
Mossel Bay ..	..	..	..	..	..	450	120	30	..	..	..	..	600
Knysna Heads..	..	..	..	..	..	..	98	8	..	..	..	..	106
Buffalo Bay ..	..	..	..	..	..	..	..	1	..	..	..	..	1
Plettenberg Bay	..	..	..	..	..	..	5	5	2	..	..	..	12
Jeffrey's Bay ..	..	..	..	..	..	20	..	..	..	..	..	..	20
Total ..	755	4,576	6,441	9 683	29,394	36,455	575	331	883	85	11,010	816	101,004

1901.

Locality.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	92	..	3,619	567	989	13	..	..	..	13	1	..	5,294
Steenberg Cove	..	10	136	241	4,667	1,256	..	..	..	2	..	..	6,312
Stompneus and Britannia Bay	15	88	427	388	11,658	2,322	2	7	..	15	29	..	14,931
Paternoster ..	..	..	36	272	5,521	3,870	..	..	..	..	..	2	9,701
Hoetjes & North Bays ..	..	274	119	1,253	19,018	7,544	..	..	..	..	..	..	28,208
Langebaan ..	..	..	..	..	1,691	594	..	..	..	..	..	..	2,285
Cape Town ..	..	..	1,300	..	23,610	34,860	..	30	600	..	..	..	60,400
Simon's Bay ..	..	..	..	..	..	..	..	20	..	..	..	213	233
Kalk Bay ..	..	..	..	..	..	..	..	70	..	..	..	1,557	1,627
Somerset Strand	..	..	..	2	4	3	..	..	..	..	9	..	18
Hermanuspetrus-fontein ..	..	..	..	..	50	75	92	225	25	..	..	..	467
Mossel Bay ..	..	..	..	..	..	..	..	57	..	..	..	..	57
Knysna Heads	..	..	..	..	..	3	10	29	6	..	..	..	48
Buffalo Bay ..	..	..	..	..	..	..	9	..	38	51	..	40	138
Plettenberg Bay	..	..	..	..	..	..	12	3	2	..	1	..	18
Total ..	107	372	5,637	2,723	67,208	50,540	125	441	671	81	40	1,812	129,747

1902.

Locality.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	..	8	534	100	38	..	..	..	1	48	..	3	732
Steenberg Cove	1	111	163	473	1,068	76	..	..	175	43	5	..	2,115
Stompneus and Britannia Bay	..	339	583	1,505	1,992	490	..	..	89	121	..	..	5,119
Paternoster ..	5	272	173	1,100	2,981	58	..	10	1,434	437	..	..	6,470
Hoetjes & North Bays ..	..	12	14	618	4,109	52	..	..	..	..	..	..	4,805
Langebaan ..	..	..	..	..	39	22	..	..	..	..	..	..	61
Cape Town ..	..	..	..	..	5,010	20	..	10	..	300	..	..	5,340
Simon's Town	..	..	..	3	..	..	..	..	..	..	..	..	3
Kalk Bay ..	..	..	..	..	..	..	..	18	358	..	..	..	376
Hermanus ..	..	..	..	..	..	400	..	..	..	..	..	..	400
Knysna Heads..	..	..	..	..	..1	..	..	..	1	1	..	..	..
Total ..	6	542	1,467	3,799	15,238	1,118	..	38	2,058	980	5	3	24,425

1903.

Locality.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay..	14	..	105	88	904	4	..	..	..	1,563	..	..	2,678
Steenberg Cove	..	440	5,000	4,394	36,129	4,156	..	..	1,504	215	..	555	52,393
Stompneus and Britannia Bay	..	829	7,313	6,476	48,477	10,876	..	16	1,18	2 238	26	2,763	78,196
Paternoster ..	173	350	3,322	3,856	15,937	19,114	..	1,487	6,976	..	..	..	51,215
Hoetjes & North Bays ..	..	..	705	1,997	2,500	2,011	3,210	1,014	83	1,490	..	17	13,027
Langebaan ..	..	..	..	..	34	21	..	..	..	..	..	..	55
Cape Town ..	2,900	300	..	70	59,870	1,450	70	90	..	9,000	7,800	22,100	103,650
Kalk Bay ..	..	..	..	..	..	..	..	..	..	..	..	1	1
Somerset Strand	..	..	12	..	14	..	16	1	38	..	..	..	81
Hermanus ..	..	..	..	..	..	4	173	105	..	..	..	..	282
Knysna Heads..	27	..	..	..	252	..	..	5	..	..	..	..	284
Plattenberg Bay	..	..	..	..	..	..	3	10	..	..	..	..	13
Jeffrey's Bay ..	..	..	..	..	..	..	..	1	..	..	..	..	1
Totals ..	3,100	1,933	16,447	16,881	164,117	37,636	3,472	2,729	9,783	12,506	7,826	25,436	301,876

1904.

Locality.	Jan.	Feb.	May.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lambert's Bay	..	..	..	2,644	288	3,557	924	..	..	..	..	..	7,413
Steenberg Cove	5,284	18,381	21,511	4,964	24,959	3,971	..	..	..	..	1,317	958	81,345
Stompneus and Britannia Bay	10,140	39,612	24,538	9,540	54,979	23,252	..	..	..	..	1,349	329	163,739
Paternoster ..	4,333	17,146	6,756	14,337	46,558	11,039	660	..	..	..	..	..	100,829
Hoetjes & North Bays ..	6	161	665	1,223	14,731	5,813	1.522	..	99	906	..	456	25,582
Langebaan ..	..	..	..	..	2,302	2,438	..	..	..	..	..	..	4,740
Cape Town ..	142,500	110,800	16,200	14,740	53,400	14,160	1,000	4,900	1,020	130	..	6,078	364,928
Simon's Town	..	..	1,523	320	1,169	..	24	..	608	..	..	..	3,644
Kalk Bay ..	..	8,000	362	..	899	69	447	428	25,867	22,550	6	..	58,628
Somerset Strand	..	..	..	..	..	4	..	..	..	227	..	1	232
Hermanus ..	..	..	..	..	..	..	500	75	300	11,000	..	..	11,875
Knysna Heads	..	..	..	..	..	1	8	2	..	..	..	..	11
Buffalo Bay ..	..	..	..	..	..	..	..	..	..	..	1,011	..	1,011
Plettenberg Bay	..	..	..	..	..	..	..	..	1	..	..	..	1
Jeffrey's Bay ..	..	..	..	..	..	1	..	..	..	..	..	..	1
Total ..	162,263	194,100	71,555	47,768	199,285	64,305	5,085	5,405	27,895	34,813	3,683	7,822	823,979

Total Number of Snoek caught at various Fishing Stations for the Years 1897–1904.

	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Lambert's Bay	35,348	41,805	38,067	17,055	5,294	732	2,678	7,413
Steenberg Cove	59,618	61,303	83,600	5,681	6,312	2,115	52,393	81,345
Stompneus and Britannia Bay ..	165,653	25,360	177,377	16,617	14,931	5,119	78,196	163,739
Paternoster	104,066	97,513	93,327	6,830	9,701	6,470	51,215	100,829
Hoetjes Bay	..	..	..	10,518	28,208	4,805	13,027	25,582
Langebaan	3,500	936	9,796	965	2,285	61	55	4,740
Cape Town	..	..	..	41,670	60,400	5,340	103,650	364,928
Simon's Town	468	3	8	12	233	3	..	3,644
Kalk Bay	3,887	93	..	19	1,627	376	1	58,628
Somerset Strand	397	247	1,582	16	18	..	81	232
Hermanus	61,561	1,867	545	882	467	400	282	11,875
Struis Bay	..	..	3	..	..	..	..	..
Mossel Bay	2,140	84	81	600	57	..	..	..
Knysna Heads	18	202	114	106	48	..	234	11
Buffalo Bay	2	782	6	1	138	..	..	1,011
Plettenberg Bay	75	11	128	12	18	..	13	1
Jeffrey's Bay	..	..	..	20	..	..	1	1
Algoa Bay	..	230	..	..	..	..	..	..
Total	436,733	328,436	405,135	101,004	129,747	24,425	301876	823,979

The returns of "salted or cured" fish exported from the Cape afford further information regarding variation in the Snoek supply, as the fish exported are chiefly Snoek.

Exports (Oversea) of Colonial Salted or Cured Fish for 1891–1912.

Year.	Weight (lbs.).	Value (£).
1891	2,243,646	17,086
1892	2,689,321	16,722
1893	1,354,503	10,474
1894	963,363	9,835
1895	1,089,408	10,650
1896	624,021	6,379
1897	1,209,351	12,966
1898	803,048	7,800
1899	984,100	12,835
1900	105,550	1,419
1901	73,680	986
1902	10	1
1903	371,526	6,521
1904	610,072	10,789
1905	74,606	1,148
1906	73,692	1,476
1907	770,794	7,605
1908	2,381,637	16,794
1909	1,317,695	13,293
1910	1,033,188	9,263
1911	1,462,763	15,724
1912	1,412,805	13,839

The nature of the "spawn" or eggs and fry of the Snoek is of great practical importance, as it has been stated that it may be destroyed by trawling operations. The opinion of some fishermen is that the reddish water (*cf.*, p. 17), which is occasionally seen in False Bay is the eggs of the Snoek, and it is looked on as a sure sign that Snoek are about. When this water is observed the Kalk Bay fishermen put out towards Cape Point for the fish, and it is stated they almost invariably find them. The usual set of the current is from Cape Point towards Simon's Town and Muizenberg, and this would of course bring the eggs into False Bay. On the other hand, at St. Helena Bay, Stumpnose, and Britannia Bay, and fishing villages in that neighbourhood, floating masses of a gelatinous consistency, in which the eggs and young, it is alleged, may be seen by the naked eye are considered to be the spawn of the fish. There can be little doubt that neither of these are in reality the eggs and fry of the Snoek, as on examination of mature Snoek, the ripe eggs were found to be colourless spheres about ·95 of a millimeter in diameter and containing an oil globule about ·23 mm. The egg of the Snoek is thus not very different from that of the most of S. African sea-fish. The relatively large size of the oil globule is a characteristic feature and will serve to distinguish it from many other fish eggs, which are otherwise similar. Of the known S. African fish-eggs it is nearest those of the Panga (*Pagrus laniarius*), which measure from 1·1 to ·93 mm. and have an oil globule of ·2 to ·19 mm. They float at the surface of the water, and were found in the months of August and September. They cannot be destroyed by any method of fishing at present practised anywhere.

Some time ago some thousands of small Snoek under the legal size were caught at Hermanus and other fishing centres. This infringement of the regulations was pointed out, and the responsible parties called to account. They, however, stated that these small Snoek were of a different species from the ordinary Snoek and never grew any larger. For lack of any definite evidence to the contrary no prosecutions were possible, and the capture of these fish continued. On scientific examination of the specimens, however, it was shown that these were certainly immature Snoek, though differing in some respects from the adult. These differences were, for instance, the relatively larger eye, which, however, is a characteristic feature of many young forms of fish. The reproductive organs in all of these small forms were undeveloped.

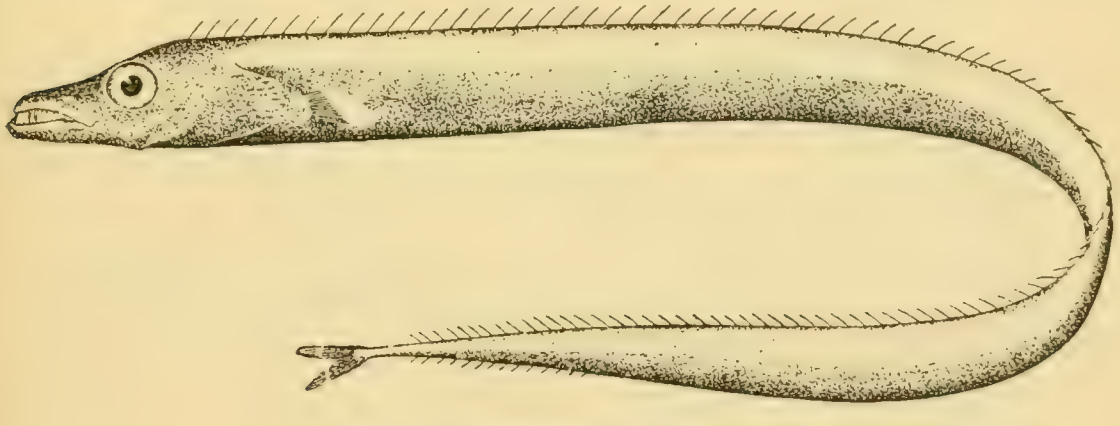
The food of the Snoek is whatever it may come across in its pelagic life; this is generally shoals of smaller fish. "Sar-

dines " at certain seasons appear close inshore, and the Snoek then eat nothing else ; again, when Mackerel congregated in shoals, the Snoek will prey on them in the absence of the " Sardines." If, however, these do not make their appearance at their usual time, the Snoek have to content themselves with what they can pick up. A few years ago (April, 1909), for instance, it was observed that Sardines, Maasbankers, Mackerel, Mullet, and small fish generally, had unaccountably forsaken False Bay for about three months. The Snoek were then found in great numbers near Cape Point at the entrance to the bay ; those caught generally had empty stomachs, but some had eaten various rock-fish and not a few had devoured their own species.

During the height of the season (April and May) the average catch for a boat has been from 1,000 to 2,000 Snoek, and as many as 2,400 have, it is stated, been caught by one boat, with four men.

The Kalk Fish (*Lepidopus caudatus*).

This is the fish already referred to as being the nearest ally of the Snoek ; it is known in Europe as the Scabbard Fish, and in South Africa as the Kalk-fish, or Kalk-visch. In New Zealand it is called the Frost-fish, as it is usually cast up on



The Kalk-fish (*Lepidopus caudatus*, Euphr.).
(From Jordan & Everman.)

the beach in frosty weather, even deliberately leaving the water and becoming stranded on the shore. The fish has the same long flat body and long dorsal fin as the Snoek, but with these characteristics much exaggerated. The body is band-like and may be 5 or 6 feet in length ; the dorsal fin extends the whole length of the body, but does not run into the tail fin, as in the next genus. The teeth are not unlike those of the Snoek, being fang-like, and occur on the roof of the mouth, as well as in the jaws. It has no scales. It might be described

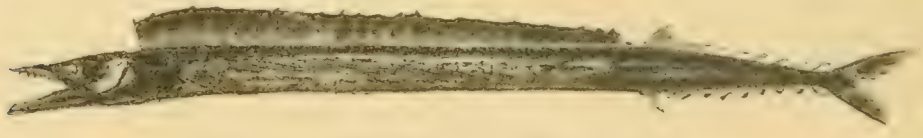
therefore, as like a Snoek, but with greater modifications for a deep-sea or pelagic life. It does not approach the coast in shoals like Snoek, and its usual habitat seems to be the surface waters of the open sea, where the higher speed, indicated by its flat powerful body, reduced ventral fins, etc., is necessary, seeing that it cannot, like its ally the Snoek, occasionally prey upon shoals of Herring and Mackerel inshore.

As might be expected, this fish of the high seas is very widely distributed. It has been recorded from American waters; it is common in Europe, South Africa, South-East coast of Australia and Tasmania, but seems to occur in greatest abundance in New Zealand, where it is esteemed as "the most delicious fish" (Sherrin), none the less so as it has the accommodating, though fatal, habit of swimming ashore.

The Snake Mackerel (*Gempylus serpens*).

This is a fish closely allied to the Kalk Fish, having a long flat body, pointed head, with projecting lower jaw, and powerful canine-like teeth. The dorsal spines are not so numerous (about 30), however, and there are separate finlets, as in the Snoek.

It is a rare fish, and is believed to be an inhabitant of very deep waters, though little is known of its mode of life. It is



The Snake Mackerel (*Gempylus serpens*).
(From photo by Mr. Brooking, East London.)

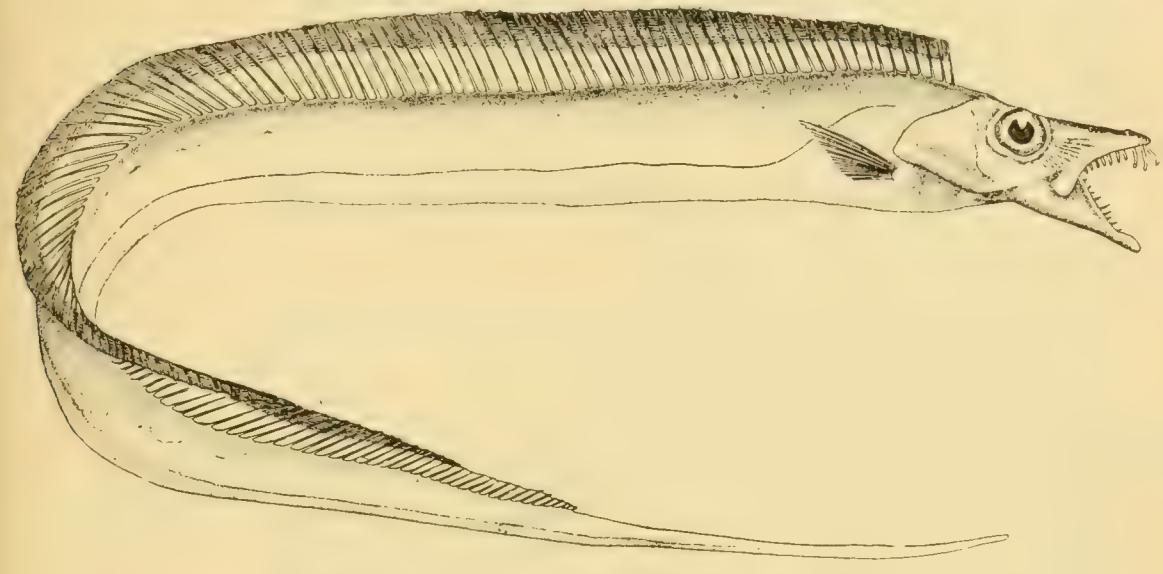
widely distributed, having been found both in the northern and southern hemispheres. A specimen has been found in South Africa by Mr. Brooking, at East London. It was found alive in a school of Mullet caught in a seine net—a fact not quite in keeping with its supposed deep-sea habits. It has no local name here, as might be expected from its rarity, and we have adopted the American popular name of Snake Mackerel.

The Hair-tail (*Trichiurus haumela*).

In its general features this fish is similar to the preceding members of the family, but instead of having a normal caudal fin, the body tapers away to a fine hair-like point, and this striking difference has led some ichthyologists to separate it from the others. This hair-like tail cannot very well function as a

steering organ, and it may well have some sensory functions ; perhaps in correlation with this, we find that the habits of the fish are different, for it mostly frequents the warm shallow waters of the tropics, sometimes even entering rivers.

It is rather rare in South Africa, being, like the Snake Mackerel, recorded here for the first time as a South African fish. Several specimens have been found by the *Picter Faure*



The Hair-tail (*Trichiurus haumela*, Euphr.).
(After Day.)

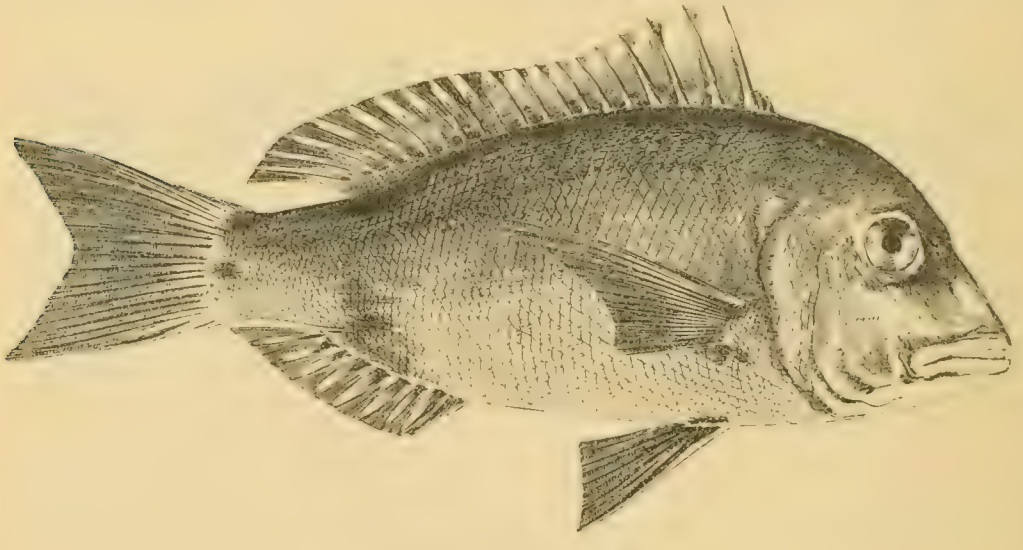
in trawling in shallow waters ; one was forwarded from East London by Mr. J. Wood, and one by Mr. Brooking, who notes that he has seen them in the Buffalo River.

All the *Trichiuridæ* are flat, elongate fish, with canine-like teeth, indicating that they are powerful swimmers, capable of sustained effort, and of a rapacious habit, in strong contrast to the rounded shorter body and undifferentiated teeth of the Mackerels (*Scombridæ*).

VII.—DESCRIPTION OF THREE NEW SOUTH AFRICAN FISHES.

Dentex albus, n. sp. (*Witte-visch*).

Canines moderately strong, 4 in upper jaw, 6 in lower. Depth of body, $2\frac{4}{5}$ times in total length; length of head, $3\frac{1}{5}$ times. Snout more than twice diameter of eye, which is $\frac{4}{5}$ interorbital width and $4\frac{1}{2}$ times in length of head; preorbital width a little greater than height, which is $1\frac{3}{5}$ times diameter of eye, scaleless; 8 series of scales between preorbital and margin of preoperculum: some small irregular scales on preoperculum, the outer margin of which is scaleless; angle rounded, vertical limb, about twice as long as the horizontal; interorbital space boldly convex, protruding; maxillary reaches to vertical of anterior third of eye and almost entirely concealed by preorbital; opercle with a blunt inconspicuous spine. Upper profile of head strongly convex, forming a quadrant of a circle from origin of dorsal fin to snout.



Dentex albus, n. sp.

Dorsal xii 10, spines weak and flexible; first 2 spines very short, 3rd and 4th about equal and $\frac{2}{5}$ length of head, the succeeding spines gradually shortening, the last being slightly lower than the soft rays. Pectoral nearly as long as head, reaching to anal rays. Ventrals $\frac{3}{5}$ length of head, not reaching vent. Anal iii 8, 2nd spine a little stronger but shorter than 3rd. Caudal forked, $\frac{7}{10}$ length of head.

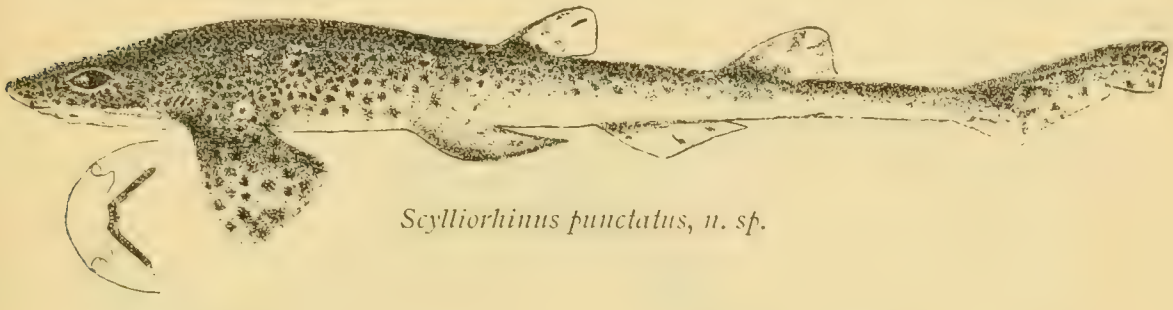
Scales on body large, each with slightly radiating striæ down the centre ; scales on head and throat below pectorals much smaller ; the scales on the head extend to the level of the upper margin of the eye. Lat. l. 60, lat. tr. 8/15.

Colour (of preserved specimen), silvery ; when fresh caught it is reddish with pale blue longitudinal streaks, which, however, disappear very quickly ; tip of spinous dorsal and of caudal blackish. The specific name given refers to the local name (Witte-visch); the fish, however, is not white, but is of a paler red than other red fish, such as Silver-fish and the colour fades rather quickly.

1 specimen, 394 mm. in length, from Table Bay.

Scylliorhinus punctatus, n.sp.

Head broad, depressed ; snout obtuse, rounded, its length more than $\frac{1}{2}$ its greatest breadth and $1\frac{1}{2}$ times the space between the nasal valves, which are not confluent, without cirri and



Scylliorhinus punctatus, n. sp.

are separated from each other by a space equal to $\frac{5}{6}$ of the distance between end of snout and mouth ; length of nasal cavity equals $\frac{3}{5}$ longitudinal diameter of eye, which is $1\frac{1}{2}$ times in length of snout. No labial folds. Distance between posterior angles of the mouth equals twice the length of the space between end of snout and mouth. Gill-openings about $\frac{1}{3}$ longitudinal diameter of eye in length, distance from first to last a little more than $1\frac{1}{2}$ times in length of snout. Teeth with a long setose central cusp and two small cusps at the base on each side. Scales of body trispinate, unequal ; larger ones occurring at intervals among the smaller on the body.

Dorsal fins equal, the length of their bases $2\frac{3}{5}$ times in the distance between them, which is $\frac{9}{10}$ the distance between base of 2nd dorsal and caudal. The 1st dorsal originates over or slightly in front of posterior end of base of ventrals ; the 2nd dorsal originates over posterior end of base of anal. Posterior margin of pectorals reaches to about mid-way between posterior end of its base and anterior end of ventrals. Distance of origin of ventrals from snout is $5\frac{1}{2}$ times

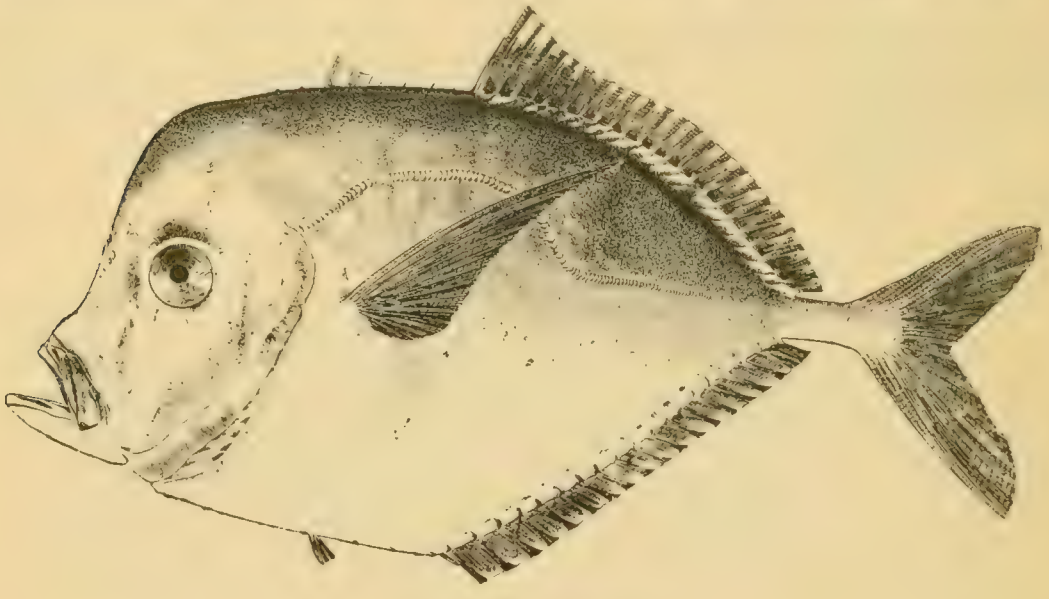
the length of snout ; posterior end of fin pointed. Anal fin ends below anterior end, or base of 2nd dorsal, the length of its base is $1\frac{4}{5}$ times in its distance from base of caudal fin.

Colour (of preserved specimen): body covered with numerous small round dark spots, which become larger laterally on sides of head, body and fins ; a few white spots occur on head, body and pectoral fins. Two faint brown narrow bands occur between gill-openings, one below base of pectorals, two across body about midway between pectorals and 1st dorsal, a faint one in front and another at base of 1st dorsal, two between the dorsal fins.

One specimen, 245 mm. in length including caudal, off Cape Point.

Selene gibbiceps, n.sp.

Teeth minute on upper jaw, a single row of larger ones on lower, a band on vomer and on tongue. Depth of body a little more than $1\frac{4}{5}$ times in total length excluding caudal,



Selene gibbiceps, n. sp.

length of head 3 times. Snout $2\frac{1}{6}$ times in length of head and twice diameter of eye, which is $4\frac{1}{3}$ times in length of head and $1\frac{1}{5}$ times interorbital width ; distance of upper margin of eye from top of head slightly greater than length of snout ; greatest height of preorbital $1\frac{3}{5}$ times diameter of eye ; cleft of mouth oblique, the chin protruding beyond upper lip when mouth is closed ; maxillary broad and reaching to vertical of nostrils. Body much elevated and compressed ; upper profile of head nearly vertical, descending in a slight concave curve to point of snout.

Dorsal ix, i 24; the first 2 spines of anterior dorsal are detached and rudimentary, the 3rd spine is highest and is connected by a membrane to the 4th and 5th, which successively decrease in height and are followed by 4 small detached spines; anterior soft rays highest, not produced, the 1st ray being a little more than $\frac{1}{3}$ length of head; outer margin of soft dorsal concave anteriorly, the remaining rays about equal in height. Pectorals slightly longer than head, reaching to above middle of anal, scythe-like in shape. Ventrals very short. Anal i 20, similar to soft dorsal, but not as high, with 3 bony scutes on the abdominal margin between 1st spine of anal and ventrals. Caudal deeply forked, $\frac{4}{5}$ length of head; caudal peduncle 3 times as long as deep. Lat. l. 140 (circa.). Scales absent on the body, except on the lateral line, which has a strong upward bend anteriorly becoming straight below the 8th or 9th soft ray of the dorsal fin.

Colour (of preserved specimen), silvery, darkish on the back, with a greenish tint posteriorly; lobes of caudal greenish with a dark outer edge; an indistinct dark patch on opercle and passing from eye to point of snout and tip of lower jaw.

The single specimen, 163 mm. in length, was procured in the Government net at Walfish Bay and was forwarded by the Resident Magistrate through Mr. G. Gale, Superintendent of Works at that place. It does not appear to be the same species as *S. vomer* in any of its various stages.

VIII.—CATALOGUE OF FISHES OF THE CAPE PROVINCE.

By W. Wardlaw Thompson, F.Z.S.

The latest catalogue of Cape Fishes was drawn up by Dr. J. D. F. Gilchrist in 1902. Since that date there have been additions and alterations and I have, at his suggestion, compiled the following revised list with the necessary additions and a fuller bibliography. It is hoped that this will prove useful from a practical as well as a scientific point of view. The lack of complete references and of access to types has been a difficulty in the work and may have led to certain defects, but it is hoped that these are as few as possible under the circumstances.

The present paper deals with the Sub-Class *Elasmobranchii* (Dog-fish, Sharks, Rays, etc.), but the local representatives of *Branchiostomatidæ* (Lancelets) and *Cyclostomata* (Hag-fish or Zee-slang) have also been included, although they do not fall under the Class *Pisces*.

I have to thank Dr. Gilchrist for his advice and assistance in the compilation of this catalogue.

CEPHALOCHORDATA.

Family **BRANCHIOSTOMATIDAE.**

(Lancelets or Amphioxus).

Branchiostoma, Costa.

Branchiostoma, Costa, Cenni Zoologici Napol. 1834, p. 49; Günth. Cat. Fish. viii, 1870, p. 513.

Amphioxus, Yarrell, British Fish. 1836, p. 468.

Branchiostoma capense, Gilchr.

Gilchr. Marine Invest. S. Africa, ii, 1894, p. 111 (False Bay, Mossel Bay, Algoa Bay).

CRANIATA.

Class CYCLOSTOMATA.

Order MYXINOIDES.

Family **MYXINE,** Linn.

Myxine, Linn.

Myxine, Linn. Syst. Nat. ed. x, i, p. 650, 1758 ; Günth, Cat. Fish. viii, p. 510, 1870 ; Jord. & Everm. Fish. N. and Mid. America, p. 7, 1896 ; Regan, Ann. & Mag. Nat. Hist., ser. 8, vol. xi., 1913, p. 395.

Gastrobranchus, Bloch, Ausl. Fische, xii, p. 66, 1795.

Myxine capensis, Regan.

Myxine capensis, Regan, Ann & Mag. Nat. Hist., ser. 8, vol. xi., 1913, p. 398 (Cape of Good Hope, 110 fms.)

Family **BDELLOSTOMATIDAE.**

Heptatretus, Duméril.

Eptatretus (Duméril) Cloquet, Dict. Sci. Nat. xv, p. 134, 1819 ; Regan, Ann. and Mag. Nat. Hist. (8) ix, 1912, p. 534.

Homea, Fleming, Philos. of Zool. ii, p. 375, 1822.

Heptatrema, Voigt, Thierr. ii, p. 529, 1832 ; Günth. Cat. Fish. viii, p. 397, 1870.

Bdellostoma, Müll. Abhandl. Akad. Berlin, 1834, p. 79.

Polistotrema, Gill, Proc. U.S. Nat. Mus. 1880, p. 30.

Heptatretus hexatrema, Müll.

(*Sea-snake, Zee-slang.*)

Bdellostoma heptatrema, Müll. Abhandl. Akad. Berlin, 1834, p. 79.

Bdellostoma heterostrema, Müll. l.c.

Bdellostoma cirrhatum (part.) Günth. Cat. Fish. viii, p. 511, 1870, and in "Challenger" Shore Fishes, p. 14, Name only, 1880 (Simon's Bay) ; Gilchr. Cat. Fish. 1902, p. 169 (South Africa).

Heptatretus hexatrema, Regan, Ann. & Mag. Nat. Hist. (8) ix, 1912, p. 536 (Simon's Bay, False Bay, Table Bay).

Class PISCES.

Sub-Class ELASMOBRANCHII.

Order PLAGIOSTOMI.

Sub-Order Selachii.

Family HEXANCHIDAE.

Heptranchias, Rafinesque.

Notidanus, Cuv. Regne Anim. ed. i, 1817.

Notidanus (*Heptanchus*), Günth. Cat. Fish. viii, p. 398, 1870.

Heptranchias, Rafinesque, Caratteri di Alcuni Nuovi Generi, p. 14, 1810.

Notorhynchus, Ayres, Proc. Calif. Ac. Sc. 1856, i, p. 72.

Heptranchias indicus, Cuv.

Notidanus indicus, Cuv. Regne Anim. 1817 ; Agassiz, Poiss. foss. iii, pp. 92, 217, pl. E, fig. 1 (teeth) 1836 ; Günth. Cat. Fish. viii, p. 398, 1870 (Cape of Good Hope to California) ; Day, Fish. India, p. 723, pl. clxxxix, fig. 4, 1878 (Madras) ; Gilchr. Cat. Fish. 1902, p. 165 (South Africa).

Heptanchus indicus, Müll. & Henle, Plag. p. 82, pl. xxxii (teeth) 1841 ; Temm. & Schleg. Faun. Japon. Poiss. p. 303, 1850 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Duméril, Elasmobr. i, p. 434, 1865 ; Macdonald & Barron, Proc. Zool. Soc. 1868, p. 371, pl. xxxiii.

Heptranchias maculatus, Girard, U.S. Pacific R.R. Exp. Fish. p. 367, 1858 ; Jord. & Gilb. Synops. p. 62, 1883 ; Jord. Tan. & Snyd. Cat. Fish. Japan, p. 7, 1913 (Sagami Sea, Japan ; Pacific coast of North America).

Notorhynchus maculatus, Ayres, Proc. Calif. Ac. Nat. Sc. 1856, i, p. 72 (San Francisco) ; Gill, Proc. Ac. Nat. Sc. Philad. 1862, p. 495, and 1864, p. 149 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 17, 1896 (Pacific coast of N. America from Monterey north to Washington ; common northwards, especially in Humboldt Bay).

Notorhynchus borealis, Gill t.c.p. 150, 1864.

Family **SCYLLIIDAE.**

Chiloscyllium, Günth.

Hemiscyllium et *Chiloscyllium*, Müller & Henle, Plagiost, 1841.
Chiloscyllium, Günth. Cat. Fish. viii, p. 410, 1870.

Chiloscyllium indicum, Gmel.

Squalus sp., Gronov. Mus. Ichth. i, p. 61, No. 133 (India), and Zoophyl. No. 150, 1763.
Squalus indicus, Gmel. Linn. Syst. Nat. i, p. 1503, 1735 ; Bl. Schn. Syst. Ichth. p. 137, 1801.
Squale dentelé, Lacép. Hist. Poiss. i, p. 281, pl. ii, fig. 1, 1798.
Squalus gronovianus, Lacép. t.c.p. 280, pl. xi, fig. 1 (Indian seas).
Squalus tuberculatus, Bl. Schn. Syst. Ichth., p. 137, 1801.
Squalus, Russell, Fish. Vizag. p. 10, *Bokee Sorrah* or *Ra Sorrah*, pl. xvi, 1803 (Coromandel coast).
Scyllium plagiosum, Benn. Life of Raffles, p. 694, 1830 (Sumatra).
Scyllium ornatum, Gray & Hardw. Ill. Ind. Zool. pl. c, fig. 1. 1834 (India).
Chiloscyllium plagiosum, Müll. & Henle, Plagiost. p. 17, 1841 ; Cantor, Malay. Fish. p. 392, 1849 ; Jerdon, Madras Journ. Lit. Sci. 1851, p. 148 ; Blkr. Verh. Bat. Gen. xxiv, Plag. p. 17, 1852 (Indian Archipelago), and Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa) ; Duméril, Elasmobr. p. 328, 1865 ; Day, Fish. Malabar, p. 267, 1865.
Chiloscyllium griseum, Müll. & Henle, t.c.p. 19, pl. 4 (not good).
Chiloscyllium tuberculatum, Müll. & Henle, t.c., p. 19; Blkr. Verh. Bat. Gen. xxiv, Plag. p. 20, 1852 (Indian Archipelago), and Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa) ; Duméril, t.c.p. 331 ; Kner, Novara, Fische, pp. 412, 413. 1865.
Squalus caudatus, Gronor. Syst. ed. Gray, p. 8, 1854 (Indian Ocean).
Scyllium hasseltii, Blkr. Verh. Bat. Gen. xxiv., Plag. p. 19, 1852.
Scyllium phymatodes, Blkr. l.c. p. 21 ; Duméril, Elasmobr. p. 331, 1865.
Hemiscyllium malayanum, Blkr. Nat. Tijds. Ned. Ind. vii, p. 376, 1854 (not Lesson), (Batjan).
Chiloscyllium magaritiferum, Blkr. Ned. Tijds. Dierck. i, p. 243, 1863 (Obi) ; Duméril, l.c.p. 329 (young).

Synchismus tuberculatus, Gill, Ann. Lyc. Nat. Hist. New York, 1861, p. 408, name only, and p. 413, pl. vii.

Chiloscyllium indicum, Günth. Cat. Fish. viii, p. 411, 1870 (Java, Moluccas, Japan, China, Ceylon, India, Cape seas); Day, Fish. India, p. 726, pl. clxxxviii, fig. 3, 1878 (seas of India to Malay Archipelago and beyond); Gilchr. Cat. Fish. 1902, p. 165 (S. Africa); Jord. & Everm. Proc. U.S. Nat. Mus, 1902 (Formosa); Jord & Fowler, Elasmobr. Fish. Japan, p. 604, 1903 (Formosa); Jord. Snyd. & Tan. Cat. Fish. Japan, p. 9, fig. 3, 1913 (coasts of China and Formosa; Nagasaki).

Scylliorhinus, Blainville.

Scylliorhinus, Blainville, Journ. de Phys. 1816, p. 263; Regan, Ann. & Mag. Nat. Hist. (8) i, 1908, p. 453.

Scyllium, Cuv. Regne Anim. ed. i, 1817, p. 124; Günth. Cat. Fish. viii, p. 400, 1870.

Catulus, A. Smith, Proc. Zool. Soc. 1837, p. 85.

Poroderma, A. Smith, l.c.

Halaelurus, Gill, Ann. Lyc. New York, vii, 1861, p. 467.

Cephaloscyllium, Gill, l.c.

Scylliorhinus africanus, Gmel.

(*Striped Dog-fish, Lui-haai, Bank-haai.*)

Squalus africanus, Gmel. Linn. Syst. Nat. i, p. 1494, 1793.

Scyllium africanum, Cuv. Regne Anim. ed. 2, ii, p. 386, 1829; Müll. & Henle, Plag. p. 12, pl. vii, 1841; Smith, Ill. Zool. S. Afr. Pisc. pl. xxv, fig. 1, 1849 (South African seas); Gray, Chondropt., p. 31, 1851 (Indian Ocean, Cape seas); Duméril, Elasmobr. p. 321, 1865; Günth. Cat. Fish. viii, p. 405, 1870 (South Africa); Gilchr. Cat. Fish. 1902, p. 164 (South Africa) ?

Scyllium var. africana, sp. striata, Günth. l.c. p. 406 (Cape seas).

Scylliorhinus africanus, Regan, Ann & Mag. Nat. Hist. (8) i, p. 454 and 456, 1908 (South Africa), and Col. Fish. 1908, p. 241 (Bird Islands).

Scylliorhinus bivius, M. & H.

Scyllium bivium (Smith) Müll & Henle, Plag. p. 8, 1841; Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 321, 1865; Günth. Cat. Fish. viii, p. 405, 1870 (Cape of Good Hope); Gilchr. Cat. Fish. 1902, p. 165 (South Africa).

Scyllium brevicolle, Philippi, An. Univ. Chile, lxxi, p. 558, pl. 7, fig. 5, 1887.

Scyllium gayi, Philippi, Zool. Garten, 1887, p. 86 (South America).

Scyllium chilense (non Guichen), Vaill. Miss. Sci. Cap Horn, Poiss. p. 10, pl. i, fig. 1, 1891.

Scylliorhinus bivius, Regan, Ann. & Mag. Nat. Hist. (8) i, p. 461, 1908 (Chile and Patagonia).

Scylliorhinus brevicollis, Delfin, Cat. Peces de Chile, p. 15, 1901.

Scyllium livium, Gray, Chondropt. p. 31, 1851 (Cape of Good Hope).

Note.—There is some doubt as to the occurrence of this species in South Africa.

Scylliorhinus capensis, Smith.

Scyllium capense, Smith. Proc. Zool. Soc. 1837; Müll. & Henle, Plagiost. p. 11, 1841; Gray, Chondropt. p. 31, 1851 (Indian Ocean; Cape Seas); Blkr. Visch. v.d. Kaap, pp. 55, 79, 1860 (Simon's Bay); Duméril, Elasmobr. p. 320, 1865; Günth. Cat. Fish, viii, p. 404, 1870 (Cape seas; Indian Ocean); Day, Fish. India, p. 724, pl. cxc, fig. 1, 1878 (Indian seas); Gilchr. Cat. Fish. 1902, p. 165 (South Africa).

Scylliorhinus capensis, Regan, Ann. & Mag. Nat. Hist. (8) i, p. 458, 1908 (South Africa).

Scylliorhinus edwardsi, Cuv.

(*Pofadder-haai*, *Schaam-oog.*)

Squalus catulus (non Linn), Edwards, Glean. Nat. Hist. iii, pl. cclxxxix, 1764.

Scyllium edwardsii, Cuv. Regne Anim. ed. 2, p. 386, 1829; Müll. & Henle, Plagiost. p. 4, pl. i, 1841; Gray, Chondropt, p. 28, 1851 (South Africa); Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 319, 1865; Günth. Cat. Fish. viii, p. 401, 1870 (Cape of Good Hope); Gilchr. Cat. Fish. 1902, p. 164 (South Africa).

Catulus edwardsii, Smith, Proc. Zool. Soc. 1837, p. 85.

Scyllium pictum, Müll. & Henle, t.c. pp 4 and 189; Blkr. t.c. p. 57, Name only (South Africa).

Scylliorhinus edwardsii, Regan, Ann. & Mag. Nat. Hist. (8) i, 1908, p. 463 (South Africa), and Ann. Natal Govt. Mus. i, pt. 3, 1908, p. 241 (Bird Islands).

Scylliorhinus natalensis, Regan.

Scyllium natalense, Regan, Ann. & Mag. Nat. Hist. (7) xiv, 1904, p. 128.

Scylliorhinus natalensis, Regan, t.c. (8) i, 1908, p. 461 (Natal and Cape Colony), and Col. Fish. 1908, p. 241 (Bird Islands).

Scylliorhinus natalensis, Gilchr. & Thomp. Ann. S. Afr. Mus. xi, pt. 2, 1911, p. 55 (Natal).

Scylliorhinus pantherinus, M. & H.

Scyllium pantherinum (Smith) Müll. & Henle, Plagiost. p. 13, 1841 ; Smith, Ill. Zool. S. Afr. Pisc. pl. xxv, fig. 2, 1849 (Algoa Bay) ; Gray, Chondropt. p. 31, 1851 (Indian Ocean ; Cape seas) ; Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa) ; Duméril, Elasmobr. p. 322, 1865.

Scyllium variegatum (Smith), Müll. & Henle, t.c.p. 14 ; Smith, t.c. pl. xxv, fig. 3 (Algoa Bay) ; Duméril, l.c.

Scyllium africanum, vars. *variegata et pantherina*, Günth. Cat. Fish. viii, p. 406, 1870 (Algoa Bay).

Scylliorhinus variegatus, Regan, Col. Fish. 1908, p. 241 (Bird Islands).

Scylliorhinus pantherinus, Regan, Ann. & Mag. Nat. Hist. (8) i, 1908, p. 456 (South Africa).

Scylliorhinus punctatus, Gilchr.

Gilchr. Mar. Biol. Rep. ii, 1914, p. 129 fig.

Family **CARCHARIIDAE.**

Carcharias, Cuv.

Carcharias, Cuv. Regne Anim. ed. i, 1817 ; Müll & Henle, Plagiost. 1841 ; Günth. Cat. Fish. viii, p. 357, 1870 ; Day, Fish. India, p. 710, 1878.

Scoliodon, Aprion or Aprinodon, Physodon, Hypoprion, Prionodon, Müll. & Henle, Wiegmann's Archiv. 1837, and Plagiost. 1841.

Prionace, Cantor, Malay. Fish. p. 399, 1849.

Eulamia, Isogomphodon, Lamiopsis, Platypodon, Hypoprionodon Isoplagiodon, et *Cynocephalus*, Gill, Ann. Lyc. Nat. Hist. New York, 1861.

Carcharias acutus, Rüpp.

Carcharias acutus, Rüpp. N. W. Fische, p. 65, pl. 18, fig. 4, 1838 (Red Sea) ; Günth. Cat. Fish. viii, p. 358, 1870 (Cape Seas, East Indian Archipelago, Singapore, Penang, Java) ; Day, Fish. India, p. 712, pl. clxxxviii, fig. 2 (Madras) 1878 ; Gilchr. Cat. Fish. 1902, p. 162 (South Africa).

Squalus russellii, Gray, Ill. Indian Zool. 1834.

Carcharias (*Scoliodon*) *acutus*, Müll. & Henle, Plag. p. 29, 1841 ; Richards. Ichth. China, p. 194, 1846 ; Cantor, Malay. Fish. p. 399, 1849 ; Gray, Chondropt. p. 41, 1851 (Indian Ocean ; China) ; Blkr. Verh. Bat. Gen. xxiv, Plag. p. 30, 1852 (Indian Archipelago) ; Duméril, Elasmobr. p. 345, 1865 (East Indies ; China) ; Kner, Novara Fische, p. 414, 1865 ; Klunz. Fisch. des rothen Meers. p. 655, 1870 (Red Sea).

Scoliodon acutus, Jord. & Fowler, Elasmobr. Fish. Japan, p. 616, 1903 (East Indies).

Carcharias melanopterus, Quoy & Gaim.

Carcharias melanopterus, Quoy & Gaim. Voy. Uran. Zool. p. 194, pl. 43, figs. 1 & 2, 1824 ; Rüpp. N. W. Fische, p. 63, 1838 ; Günth. Fish. Zanz. p. 142, 1866 (Red Sea), and Cat. Fish. viii, p. 369, 1870 (Indian Ocean and Archipelago ; Amboyna) ; Klunz. Fisch. R. Meers. p. 658, 1870 ; Day, Fish. India p. 715, pl. clxxxv, fig. 3, 1878 (Andamans) ; Gilchr. Cat. Fish. 1902, p. 163 (South Africa) ; Jord. & Seale, Fish. Samoa, 1906, p. 182 (Hawaii, Samoa, etc.).

Carcharias (*Prionodon*) *melanopterus*, Müll. & Henle, Plag. p. 43, pl. 19, fig. 5, 1841 ; Richards. Ichth. China, pp. 194 and 317, 1846 ; Blkr. Verh. Bat. Gen. xxiv, Plag. p. 33, 1852 (East Indian Archipelago) ; Duméril, Elasmobr. p. 365, 1865 ; Kner, Novara Fische, p. 415, 1865 ; Steindr. Fische Südarab. Sokotra, p. 38, 1902 (Sokotra).

Carcharias (*Prionace*) *melanopterus*, Cantor, Malay. Fish. p. 400, 1849.

Carcharias (*Prionodon*) *henlei*, Blkr. Nat. Tijds. Ned. Ind. iv, 507, 1853 (Batavia).

Carcharias (*Prionodon*) *brachyrhynchus*, Blkr. Act. Soc. Sc. Indo-Neerl. vi, p. 206, 1859 (East Indian Archipelago) ; Duméril, t.c.p. 364, 1865.

Squalus (*Carcharinus*) *melanopterus*, Gray, Chondropt. p. 46, 1851 (Cape seas, Red Sea, Australia, Moluccas, China).

Galeorhinus, Blainville.

Galeorhinus, Blainv. Bull. Soc. Philom. 1816, p. 121 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 31, 1896.

Galeus, Rafinesque, Caratteri, p. 13, 1810 (in part, without mention of species) ; Cuv. Regne Anim. ed. i, 1817, p. 127 ; Günth. Cat. Fish. viii, p. 379, 1870.

Eugaleus, Gill, Proc. Ac. Nat. Sc. Philad. 1864, p. 148.

Galeorhinus canis, Bonap.

(*The Tope, Dog-fish, Darwen Salmon.*)

Galeus canis, Rondel. De Pisc., p. 377, 1554 ; Bonap. Faun. Ital. Pesc. iii, tab. 132, fig. 3, 1840 ; Müll. & Henle, Plag., p. 57, 1841 ; Gaimard, Voy. Isl. et Groenl. Poiss. pl. 21, 1851 ; Gray, Chondropt., p. 52, 1851 (Atlantic and Indian Oceans, Antarctic, Cape, British coast) ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Duméril, Elasmobr., p. 390, 1865 ; Bocage & Capello, Peix. Plagiost., p. 18, 1866 (Portugal) ; Günth. Cat. Fish. viii, p. 379, 1870 (British coast, Mediterranean, Cape seas, Indian Ocean, Antarctica, Tasmania, San Francisco) ; Wright & Ekstr. Skand. Fisk., p. 185, pl. 45, 1893 ; Gilchr. Cat. Fish. 1902, p. 163 (South Africa).

Canis galeus, Salvian. p. 130, fig. 41, 1554 (Italy) ; Willughby, Hist. Pisc., p. 51, pl. B6, fig. 1, 1686.

Squalus sp. Artedi, Gen. p. 68, No. 9 ; Synon. p. 97, 1738.

Squalus galeus, Linn. Syst Nat. ed. x, i, p. 399, 1758 ; Brünn. Pisc. Massil. p. 9, 1768 ; Bl. Ichth., p. 118, 1797 ; Bl. Schn. Syst. Ichth. p. 128, 1801 ; Turton, British Faun. p. 112, 1807 ; Risso, Ichth. Nice, p. 32, 1810 ; Jenyns, Man. p. 501, 1835 ; Nilss. Skand. Faun. Fisk. p. 714, 1836 ; Couch., Fish. British Isl. i, p. 45, pl. 9, 1861.

Milaudre, Duhamel, Pesch. ii, p. 20, figs. 1 and 2, 1777 ; Lacép. Hist. Poiss. i, p. 237, 1798 (Mediterranean ; Atlantic).

Tope, Pennant, British Zool. iii, p. 98, 1769, or ed. 1812, iii, p. 146 (not pl. 18).

Carcharias galeus, Risso, Eur. Mérid. iii, p. 121, 1827.

Galeus vulgaris, Fleming, British Fish. p. 165, 1828 ; Kröyer, Danm. Fisk. p. 834, 1838 ; Yarrell, British Fish. 2nd ed. ii, p. 509, 1841, or 3rd ed. ii, p. 491, 1859 ; Parn. Werner. Mem. vii, p. 414 ; Herdm. & Daw. Fish. Irish Sea, p. 63, 1902 (British Seas).

Galeorhinus canis, Smitt, Scand. Fish. p. 1132, pl. 4, fig. 2, 1895.

Galeus communis, Owen, Osteol. Cat. i, p. 92, 1853.

Leptocarcharias, Günth.

Leptocarias, Smith, M.S.

Leptocarcharias, Günth. Cat. Fish. viii, p. 384, 1870.

Triaenodon, Müll. & Henle, Plag. p. 56, 1841 (part).

Leptocarcharias smithii, M. & H.

Triaenodon smithii, Müll. & Henle, Plag. p. 56, pl. 21, 1841 ; Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa).

Leptocarcharias smithii, Gray, Chondropt. p. 51, 1851 (Southern Ocean) ; Günth. Cat. Fish. viii, p. 384, 1870 (South Africa, Cabenda Bay) ; Gilchr. Fat. Fish. 1902, p. 163 (South Africa).

Mustelus, Cuv.

Mustelus, Cuv. Regne Anim. ed. i, p. 128, 1817 ; Gill. Proc. Ac. Nat. Sc. Philad. 1864, p. 148 ; Günth. Cat. Fish. viii, p. 385, 1870 ; Jord. & Everm. Fish. N. and Mid. America, p. 28, 1896.

Mustelus Canis, Mitchell.

(*Smooth Hound.*)

Galeus asterias, Rondel. p. 377, 1554.

Smooth Hound, Penn., British Zool. iii, p. 102, pl. 16, 1769, or ed. 1812, iii, p. 151 ; Couch, Fish. Brit. Isl. i, p. 47, pl. 10, 1861 (British Coasts).

Squalus émissole, Lacép. Hist. Poiss. i, p. 242, 1798 (Atlantic and Pacific Oceans).

? *Squalus mustelus*, Bl. Schn. Syst. Ichth. p. 128, 1801 ; Risso, Ichth. Nice, p. 33, 1810.

Squalus canis, Mitch. Trans. Lit. Phil. Soc. New York, 1815, i, p. 486 (New York).

Mustelus asterias, Cloquet, Dict. p. 407, 1820 (Europe).

Mustelus stellatus, Risso, Eur. Mérid. iii, p. 126, 1827 (Nice).

Squalus hinnulus, Blainv. Faun. Franc. p. 83, pl. 20, fig. 2, 1828 (Mediterranean).

Galeorhinus hinnulus, Blainv. t.c., p. 83, pl. 20, fig. 2 ; Thompson, Ann. Nat. Hist. 1839, ii, p. 272, and Nat. Hist. Ireland, iv, p. 252, 1856.

Galeus mustelus, Leach, Wern. Mem. ii, p. 63, pl. 2, fig. 3.

Mustelus plebejus, Bonap. Faun. Ital. Pesc. viii, p. 43, pl. 132, 1834 (Italy).

Mustelus vulgaris (part), Müll. & Henle, Plag. p. 64, 1841.

Mustelus vulgaris, Müll. Abhandl. Ak. Wiss. Berlin, 1840, p. 187, pl. 3, fig. 2; Müll. & Henle, Plag. p. 190, pl. 27, fig. 1, 1841 (Europe); Gray, Chondropt. p. 56, 1851 (English coast, Mediterranean, Cape Seas, Antarctic, New Zealand); Yarrell, British Fish. 3rd ed. ii. p. 495, 1859; Blkr. Visch v.d. Kaap, p. 57, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 400, pl. 3, figs. 1-3, 1865 (teeth); Bocage & Capello, Peix. Plagiost. p. 16, 1866 (Portugal): Günth. Cat. Fish. viii, p. 386, 1870 (British Isles, Guernsey); Herdm. & Daw. Fish. Irish Sea, p. 64, 1902; Gilchr. Cat. Fish, 1902, p. 163 (South Africa); Regan, Col. Fish. 1908, p. 241 (Bird Islands).

Mustelus canis, Storer, Fish. Massachusetts, p. 227, pl. 37, fig. 2, 1867; Jord. & Gilbert, Snyops. 1883, p. 870; Jord. & Everm. Fish. N. and Mid. Amer., p. 29, 1896 (Cape Cod to Cuba and Southern Europe, abundant on Atlantic coasts of both continents especially off New York and in the Mediterranean).

Mustelus laevis, Risso.

Γαλεὸς λεῖος, Aristotle, Hist. anim. vi, c. 10, edit. Gazae, 1503.

Galeus hinnulus, Bellon. De Aquat. p. 71, 1553 (Mediterranean).

Galeus laevis, Rondel. p. 375, 1554.

Squalus mustelus (part), Linn. Syst. Nat. i, p. 400, ed. x, 1758.

Mustelus laevis, Risso, Eur. Mérid. iii, p. 127, 1827: Müll. Abhandl. Ak. Wiss. Berlin, 1840, p. 187, pl. 3, fig. 1; Müll. & Henle, Plag. p. 190, pl. 27, fig. 2, 1841; Gray, Chondropt. p. 57, 1851 (locality unknown); Duméril, Elasmobr. p. 401, 1865, pl. 3, figs. 4-6 (teeth); Günth. Cat. Fish. viii, p. 385, 1870 (Lisbon, Madeira, Cape seas, New York); Gilchr. Cat. Fish. 1902, p. 163 (South Africa).

Mustelus punctulatus, Risso, t.c. p. 128.

Squalus mustelus, Blainv. Faun. Franc. Poiss. p. 81, pl. 20, fig. 1, 1828.

Mustelus equestris, Bonap. Faun. Ital. Pesc. 1840.

Mustelus megalopterus, Smith, Ill. Zool. S. Afr. Pisces, pl. 2, 1849 (Cape of Good Hope); Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa).

Mustelus vulgaris (part), Müll. & Henle, t.c. p. 64.
Pleuracromylon laevis, Gill. Proc. Ac. Nat. Sc. Philad. 1864, p. 148.

Mustelus natalensis, Steindr.

Steindr., Sitzgsber. Ak. Wiss. Wien, 1866, liii, p. 482, taf. 1 (Port Natal).

Family **SPHYRNIDAE.**

Sphyrna, Rafinesque.

Sphyrna, Rafinesque, Indice d' Ittiol. Siciliana, p. 60, 1810 and in Müll. & Henle, Plagiost. 1841 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 43, 1896.
Cestrorhinus, Blainville, Journ. Phys. p. 364, 1816.
Zygaena, Cuv. Regne Anim. ed. 1, p. 127, 1817 ; Günth. Cat. Fish. viii, p. 380, 1870.
Cestracion, Klein, Pisc. Miss. iii, p. 12, 1749 ; Gill, Ann. Lyc. Nat. Hist. New York, viii, 1861, p. 412.
Platysqualus, Swains. Classn. Anim. ii, p. 318, 1839.
Eusphyra et Reniceps, Gill, t.c.p. 412.

Sphyrna malleus, Risso.
(*Hammer-headed Shark*).

Libella, Bellon. De Aquat. p. 61, 1553 (Mediterranean) ; Salvian. p. 128, tab. 40, 1554 (Italy) ; Aldrov. p. 408, 1638 ; Jonston, tab. 7, fig. 8, 1657 ; Willughby, pl. D1, 1686 ;
Zygaena, Rondel. p. 389, 1554 ; Gesner, De Aquat. p. 1050.
Squalus sp. Artedi, Gen. p. 44, No. 7, 1738 ; Synon. p. 96, No. 7, 1738 ; Gronov. Mus. Ichth. i, pp. 63, 139, 1754 and Zoophyl. p. 146, 1763.
Zygène, Dutertre, Hist. Nat. ii, p. 207. 1667 ; Duhamel, Pesches ii, sect. ix, pl. 21, figs. 3-8, 1769-1777.
Squalus zygaena, Linn. Syst. Nat. p. 399, 1758 (Europe, America) ; Bl. tab. 117, 1797 ; Bl. Schn. p. 131, 1801 ; Lacép. i, p. 257, 1798 ; Brünn. Pisc. Massil. p. 4, 1768 (Marseilles) ; Forsk. Descr. anim. p. xviii, 1844 ; Mitch. Trans. Lit. & Phil. Soc. New York, i, p. 284, 1815 ; Gronov. Syst. ed. Gray p. 6, 1854 (North Sea.)
Cestracion sp. No. 1, Klein, Pisc. Miss. iii, p. 13, 1749.
Corunda, Parra, lam. 32, 1787 (Havana).
Koma sorra, Russell, Fish. Vizag. p. 12, 1803 (India).

Squalus malleus, Risso, Ichth. Nice, p. 34, 1810 (Nice).

Zygaena malleus, Shaw, Nat. Misc. pl. 267; Val. Mém. Mus. ix, 1832, p. 223, pl. ii, fig. 1; Risso, Eur. Mérid. iii, p. 125, 1827; Cantor, Quart. Med. Journ. Calcutta 1837, fig. 1; Schleg. Faun. Japon. Poiss. p. 306, pl. 138, 1850 (Japan); Jenyns, Man. p. 507, 1835 (British Isles); Yarrell, Brit. Fish. 2nd ed. ii, p. 504, 1841 or 3rd ed. ii, p. 486; Dekay, New York Faun. Fish., p. 362, pl. 62, fig. 204, 1842; Blkr. Verhdl. Bat. Gen. xxiv, 1852, Plag. p. 42, pl. 3, fig. 8 (Indian Archipelago); Couch, Fish. Brit. Isl. i, p. 70, pl. 16, 1861; Storer, Proc. Bost. Soc. Nat. Hist. i, p. 36; Mem. Amer. Acad. ix, 1867, p. 229, pl. xxxviii, fig. 2; and Fish. Massachusetts p. 238, 1867; Günth. Fish. Zanz. p. 142, 1866 (Aden, Zanzibar, Seychelles), and Cat. Fish. viii, p. 381, 1870 (Mediterranean, Madeira, W. Africa, British Guiana, Zanzibar, Seychelles, Penang, Moluccas, Formosa, Amoy, Japan, S. Australia, Feejee Islands); Klunz. Fisch. Roth. Meer, p. 666, 1871 (Red Sea); Day, Fish. Ind. p. 719, pl. clxxxvi, fig. 4 (Indian seas) 1878; Günth, "Challenger," Shore Fish. pp. 58, 59 (Name only), 1880 (Tongatabu, Honolulu); McCoy, Prodr. Zool. Vict. vi, 1881, pl. lvi, fig. 1 (Australia); Nystrom, Kong. Svensk. Vet. Ak. 1887, p. 49 (Nagasaki).

Zygaena lewini, Lord, in Griff. An. Kingd. x, p. 640, pl. 50, 1834 (New Holland).

Sphyrna zygaena, Müll. & Henle, Plag. p. 51, 1841; Bonap. Faun. Ital. Pesc. 1840; Richards. Ichth. China, p. 194, 1846; Cantor, Malay. Fish. p. 401, 1849; Blkr. Bengal. p. 80, 1853; Bocage & Capello. Peix. Plag. p. 17, 1866 (Portugal); Jord. & Gilbert, Synops. p. 25, 1883; Jord. & Everm. Fish. N. and Mid. America, p. 45, 1896 (Cape Cod, Point Conception); Jord. & Seale, Fish. Samoa, p. 163, 1896 (Samoa, Hawaii, etc.), and Fish. Luzon & Panay, p. 3, 1907 (Cavite); Jord & Fowler, Elasmobr. Fish. Japan, p. 618, 1903 (Nagasaki, etc.); Jord Tan. & Snyd. Cat. Fish. Japan, p. 14, 1913 (as far as North as Tokyo).

Zygaena subarcuata, Storer, Proc. Boston Soc. Nat. Hist. 1848, p. 70 (Cape Cod).

Sphyrnias zygaena, Gray, Chondropt, p. 48, 1851 (Mediterranean, Demerara, Sumatra).

Cestracion zygaena, Gill, Ann. Lyc. Nat. Hist. New York, viii, 1861, p. 403; Duméril, Elasmobr. p. 382, 1865; Day, Fish. Malabar, p. 270, 1865.

estracion leeuwenii, Duméril, t.c.p. 383.

Sphyrna lewini, Waite, Mem. Austr. Mus. iv, 1899, pt. 1, p. 34 (Australian Seas); McCulloch, Fish. "*Endeavour*" p. 9, 1911 (Bass Strait).

Note.—The Hammer-headed Shark is plentiful at Algoa Bay and Mossel Bay, and is reported from Muizenberg, False Bay.

Family **LAMNIDAE.**

Lamna, Cuv.

Lamna, Cuv. Regne Anim. ed. 1, p. 126, 1817; Günth. Cat. Fish. viii, p. 389, 1870; Jord. & Everm. Fish. N. and Mid. America, p. 49, 1896.

Lamia, Risso, Eur. Mérid. iii, p. 123, 1826.

Selanonius, Fleming, British Fish. p. 169, 1828.

Oxyrhina, Agassiz, Poissons fossiles, iii, 1836.

Lamna et Oxyrhina, Müll. & Henle, Plagiost. 1841.

Lamna glauca, M. & H.

Lamna glauca, Müll & Henle, Plag. p. 69, pl. 29, 1841 (Nagasaki); Günth. Cat. Fish. viii, p. 391, 1870 (Japan, Cape seas, St. Helena); Gilchr. Cat. Fish. 1902, p. 163 (South Africa).

Oxyrhina glauca, Müll. & Henle, t.c.p. 69, pl. 29; Schleg. Faun. Japon, Poiss. p. 303, 1850 (Nagasaki); Duméril, Elasmobr. p. 409, 1865.

Isuropsis glauca, Jord. & Fowler, Elasmobr. Fish. Japan, p. 623, 1903 (Japan); Jord. & Snyder, Col. Fish. Japan, p. 234, 1904 (Japan).

Carcharodon, Smith.

Carcharodon, A. Smith, Proc. Geol. Soc. London, 1837, p. 86; Müll. & Henle, Plag. p. 70, 1841; Günth. Cat. Fish. viii, p. 391, 1870; Jord & Everm. Fish. N. and Mid. America, p. 50, 1896.

Carcharodon rondeleti, M. & H.

(*Man-eater Shark, Great White- or Great Blue-Shark.*)

Lamia, Rondel, p. 305, 1558 (Nice; Marseilles); Gesner, De Aquat, p. 173, 1560, Aldrov. p. 383, 1638.

Squalus carcharias, Linn. Syst. Nat. ed. x, 1758, p. 235 (Europe).

Carcharias verus, Agass. Poiss. foss. iii, p. 91, tab. F, fig. 3 (teeth), 1836.

Carcharias smithii, Bonap. Selach. Tab. Anal. p. 9, 1839, after Smith.

Carcharodon lamia, Bonap. Faun. Ital. Pesc. 1840.

Carcharodon rondeletii, Müll. & Henle, Plag. p. 70, 1841 (Mediterranean; Atlantic Ocean); Blkr. Visch. v.d. Kaap. p. 57, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 411, 1865; Bocage & Capello, Peix. Plag. p. 13, 1866 (Portugal); Günth. Cat. Fish. viii, p. 392, 1870 (From Mediterranean to Australia); Phil. An. Univ. Chile, lxxi, p. 50, pl. iv, fig. 4 (teeth), 1887; Delfin, Cat. Peces Chile, p. 20, 1901 (Talcahuano); Gilchr. Cat. Fish. 1902, p. 164 (Cape Seas).

Carcharias atwoodi, Storer, Proc. Boston Soc. Nat. Hist. iii, 1848, p. 71 (Province Town, Massachusetts), and Mem. Amer. Acad. ix, 1867, p. 222, pl. 36, fig. 4.

Carcharodon capensis, Smith, Ill. Zool. S. Afr. Pisces, pl. 4, 1849 (Cape Seas); Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa).

Carcharodon carcharias, Jord. & Gilbert. Synops. p. 875, 1883; Jord. & Fowler, Elasmobr. Fish. Japan, p. 625, 1903 (Japan); Jord. & Everm. Fish. N. and Mid. America, p. 50, 1906 (Northern seas); Jord. & Seale, Fish. Samoa, p. 183, 1906 (Hawaii); Jord. Tan. & Snyd. Cat. Fish. Japan, p. 16, 1913.

Odontaspis, Agassiz.

Odontaspis, Agass. Poiss. foss. iii, p. 87, 1836; Günth. Cat. Fish. viii, p. 392, 1870.

Triglochis, Müll. & Henle, Mag. Nat. Hist. 1838, ii, p. 88.

Carcharias, Jord. & Everm. Fish N. and Mid. America, p. 46, 1896.

Odontaspis americanus, Mitch.

Squalus americanus, Mitch. Phil. & Lit. Trans. New York, i, 1815, p. 483 (New York); Dekay, New York Faun. Fish. p. 366, 1842; Storer, Boston Journ. Nat. Hist. iv, 1844, p. 188.

Squalus littoralis, Le Sueur, Journ. Ac. Nat. Sc. Philad. i, 1817, p. 224; Mitch. Amer. Month. Mag. ii, 1818, p. 328; Dekay, t.c.p. 351.

Squalus macrodus, Mitch, t.c.p. 328 (New York).

Odontaspis taurus (Rafinesque) Müll. & Henle, Plag. p. 73, pl. 30, 1841; Gray, Chondropt. p. 63, 1851 (Mediterranean; Cape seas); Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 417, 1865.

Odontaspis americanus, Abbott, Proc. Ac. Nat. Sc. Philad. 1861, p. 399 ; Günth. Cat. Fish. viii, p. 392, 1870 (Atlantic, South Pacific, Australia, Tasmania, Cape seas) ; Gilchr. Cat. Fish. 1902, p. 164 (South Africa).

Engomphodus littoralis, Gill, Proc. Ac. Nat. Sc. Philad. 1864, p. 260.

Carcharias americanus, Jord. & Gilbert, Synops. p. 27, 1883.

Carcharias littoralis, Jord. & Everm. Fish. N. and Mid. America, p. 46, 1896 (Atlantic coast of North America—Cape Cod to Cape Hatteras especially).

Alopias, Rafinesque.

Alopias, Rafinesque, Caratteri di Alcuni Nuovi Generi, p. 12, 1810.

Alopias (Alopecias), Müll. & Henle, Plag. p. 74, 1841 ; Günth. Cat. Fish. viii, p. 393, 1870.

Alopias vulpes, Gmel.

(*Thresher- or Thrasher-Shark.*)

Simia, Bellon. De Aquat. p. 65, 1553 (Mediterranean).

Vulpes, Rondel. p. 387, 1554 (Europe) ; Gesner, De Aquat. p. 1043, 1560.

Vulpecula, Salvian. p. 134, pl. 42, 1554 ; Aldrovand. p. 396, 1638 ; Jonston, De Pisc. tab. 7, fig, 3, 1649 ; Willughby, tab. B6, fig. 2, 1686.

Singe de mer, Belon, Nat. et Divers. des Poiss. p. 88, 1555.

Renard marin, Perrault, Mem. Ac. Sc. iii, pls. 15, 16, 1699 ; Duhamel, Pesch. ii, sect. ix, p. 303, pl. 21, figs. 1 & 2, 1777 ; Lacép. Hist. Poiss. i, p. 267, 1798 (Mediterranean ; English and Scottish coasts ; The ocean).

Squalus No. 8, Artedi, Gen. p. 68, Synon. p. 96, 1738.

Galeus cauda longa, Klein, Pisc. Miss. iii, p. 10, 1749.

Sea-fox, Thresher or Thrasher, Borlase, Cornw. p. 265, 1758 (Cornwall) ; Couch, Fish. Brit. Isl. i, p. 37, pl. 7, 1861 (British coast).

Long-tailed Shark, Penn. British Zool. iii, p. 97, pl. 14, 1769 or ed. 1812, iii, p. 145, pl. 17.

Squalus vulpes, Gmel. Linn. Syst. Nat. ed. xiii, i, p. 1496, 1788 (Mediterranean) ; Lacép. t.c.p. 267 ; Bl. Schn. Syst. Ichth. p. 127, 1801 ; Turton, British Faun. p. 102, 1807 ; Mitch. Phil. Lit. Trans. New York, 1815, i, p. 482 ; Blainv. Faun. Franc. p. 94, pl. 14, fig. 1, 1828.

Squalus vulpinus, Bonnat. Tab. Encycl. Ichth. p. 9, 1788 (Mediterranean).

Carcharias vulpes, Cuv. Regne Anim. 1817 ; Risso, Ichth. Nice, p. 36, 1810, and Eur. Mérid. iii, p. 120, 1827 (Europe) ; Dekay, New York Faun. Fish. p. 348, pl. 61, fig. 199, 1842 ; Guichen. in Gay's Chile, Zool. ii, p. 363, 1848, and Explor. Algér. p. 124, 1850.

Alopias vulpes, Kröy. Danm. Fisk. iii, pp. 929 and 937, 1838 ; Bonap. Faun. Ital. Pesc. iii, p. 66, 1840 (Italy) ; Yarrell, British Fish. 2nd ed. ii, p. 522, 1841, or 3rd ed. ii, p. 512, 1859 ; Müll. & Henle, Plag. p. 74, tab. 35, fig. 1 (teeth), 1841 ; Storer, Mem. Amer. Acad. ii, p. 505 ; Gray, Chondropt. p. 64, 1851 (Mediterranean ; Cape seas ; the ocean) ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860, (South Africa) ; Duméril. Elasmobr. p. 421, 1865 ; Bocage & Capello, Peix. Plag. p. 14, 1866 (Portugal) ; Jord. & Gilbert, Synops. p. 27, 1883 ; Day, Fish. Grt. Britain and Ireland, ii, p. 300, 1884, and Fish. India, p. 810, 1888 (Atlantic Ocean, both shores ; Ceylon ; Cape of Good Hope ; New Zealand ; Mediterranean ; San Francisco Bay ; California) ; Vaill. Bull. Soc. Philom. Paris, 1885 ; Jord & Everm. Fish. N. and Mid. America, p. 45, 1896 (Mediterranean ; Atlantic ; Pacific coast of North America) ; Delfin, Cat. Peces Chile, p. 18, 1901 (Valparaiso, Concepcion, etc.) ; Herdm. & Daw. Fish. Irish Sea, p. 64, 1902 (Dublin Bay, etc.) ; Jord. & Fowler, Elasmobr. Fish. Japan, p. 619, 1903 (Japan coasts) ; Jord. & Seale, Fish. Samoa, p. 183, 1906 (Hawaii, etc.).

Alopias macrourus, Rafinesque, Caratteri di Alc Nuovi Gen. p. 12, 1840 (Sicily).

Alopecias vulpes, Yarrell, British Fish. ed. 3, ii, p. 512, 1859 ; Günth. Cat. Fish. viii, p. 393, 1870 (English coast ; Mediterranean ; Atlantic ; Cape seas) ; Perez, Escualos de Chile, p. 5, 1886 ; Phil. An. Univ. Chile, lxxi, 1887, p. 551, pl. v, figs. 1*a*, 1*b* ; Navar. Man. Ictiol. Mar. Espana i Baleares, p. 53, 1899 (Spanish coasts) ; Gilchr. Cat. Fish. 1902, p. 164 (South Africa).

Squalus alopecias, Gronov. Syst. ed. Gray, p. 7, 1854 (French seas ; Mediterranean).

Family **RHINODONTIDAE.**

Rhinodon, Smith.

Rhinodon, A. Smith, Ill. Zool. S. Afr. Pisces, pl. 26, 1849 ; Günth. Cat. Fish. viii, p. 396, 1870.

Rhincodon, Jord. & Fowler, Elasmobr. Fish. Japan, p. 626, 1903.

Rhinodon typicus, Smith.

Rhinodon typicus, Smith, Ill. Zool. S. Afr. Pisces, pl. 26, 1849 (Cape of Good Hope) ; Müll. & Henle, Plag. p. 77, tab. 35, fig. 2 (teeth), 1841 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (S. Africa) ; Duméril, Elasmobr. p. 428, 1865 ; Günth. Cat. Fish. viii, p. 396, 1870 (Cape of Good Hope ; Seychelles) ; Haly, Ann. & Mag. Nat. Hist. (5) xii, p. 48 ; Day, Fish. Ind. p. 811, 1888 (West coast Ceylon) ; Gilchr. Cat. Fish. 1902, p. 165 (South Africa).

Rhinodon pentalineatus, Kishinouye, Zool. Anz. 1891, p. 694 (Cape Inubo, Japan).

Rhineodon typicus, Jord. & Fowler, Elasmobr. Fish. Japan, p. 626, 1903 (Cape Inubo) ; Jord. Tan. & Snyd. Cat. Fish. Japan, 1913, p. 17 (Cape of Good Hope ; Seychelles ; Japan).

FAMILY **SQUALIDAE.**

Acanthias, Risso.

Acanthias sp., Risso, Eur. Mérid. iii, p. 131, 1827.

Acanthias, Müll. & Henle, Plag. 1841 ; Günth. Cat. Fish. viii, p. 417, 1870.

Squalus et Eutoxychirus, Gill, Proc. Ac. Nat. Sc. Philad. 1862, p. 496.

Acanthias blainvillei, Risso.

Acanthias blainvillei, Risso, Eur. Mérid. iii, p. 133, pl. 3, fig. 6, 1827 (Europe) ; Müll. & Henle, Plag. p. 84, 1841 ; Bonap. Cat. Met. Pisc. Eur. p. 15, 1850 ; Gray, Chondropt. p. 70. 1851 (Mediterranean ; Cape seas) ; Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 438, 1865 ; Bocage & Capello, Peix. Plag. p. 21, 1866 (Portugal) ; Günth. Cat. Fish. viii, p. 419, 1870 (Lisbon ; Adriatic ; Cape of Good Hope ; New Holland). and " Challenger," Shore Fishes, p. 23, 1880 (Juan Fernandez) ; Gilchr. Cat. Fish. 1902, p. 166 (South Africa).

Spinax blainvillei, Agass. Poiss. foss. iii, p. 62, tab. B, 1836 ; Bonap. Faun. Ital. Pesc. 1840.

Squalus blainvillei, Delfin, Cat. Peces Chile, p. 22, 1901 (Juan Fernandez).

Acanthias vulgaris, Risso.

(*Dog-fish.*)

Ακανθίας γαλεὸς, Aristotle, vi, c. 10 & ix, c. 37, ed. Gazae, 1503 (Ægean Sea) ; Athenaeus, De Pisc. vii, p. 294, A.D. 150.

Mustelus spinax, Bellon. De Aquat. pp. 69 & 70, 1553 (Mediterranean).

Galeus acanthias, Rondel. p. 373, 1554 ; Gesner, De Aquat. p. 607, 1560 ; Aldrov. p. 399, 1638 ; Jonston, i, tab. 8, fig. 5, 1649 ; Willughby, p. 56, tab. B5, fig. 1, 1686 ; Klein, Pisc. Miss. iii, p. 8, tab. 1, figs. 5 and 6, 1749.

Squalus sp., Artedi, Gen. p. 66, No. 3, Synon. p. 94, No. 3, Spec. p. 102, No. 1, 1738 ; Gronov. Zoophyl. No. 149, 1763 and Mus. Ichth. i, p. 61, No. 139, 1754.

Squalus acanthias, Linn. Syst. Nat. ed. x, 1758, i, p. 233, and ed. xii, 1766, p. 397 (Coast of Europe) ; Bl. Ichth. taf. 85, 1797 ; Bl. Schn. Syst. Ichth. p. 135, 1801 ; Turton, British Faun. p. 114, 1807 ; Donovan, British Fish. iv, p. 82, 1808 ; Risso, Ichth. Nice, p. 40, 1810 (Mediterranean) ; Faber, Fisch. Isl. p. 129, 1829 ; Blainv. Faun, Franc. p. 57, 1828 ; Jenyns, Man. p. 505, 1835 ; Fries och Ekstr. Skand. Fisk. p. 187, tab. 46, 1836 ; Gronov. Syst. ed. Gray, p. 8, 1854 (European seas) ; Jord. & Gilbert, Synops. p. 16, 1883 ; Berg, An. Mus. Nac. Buenos Ayres, iv, 1895, p. 5 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 54, 1896 (Atlantic coast of North and Middle America and to Cuba) ; Delfin, Cat. Peces Chile, p. 21, 1901 (Straits of Magellan ; Atlantic, Mediterranean to coasts of U.S. America) ; Regan, Ann. and Mag. Nat. Hist. (8) ii, 1908, p. 46 (Atlantic coasts of Europe and North America, and southwards to Mediterranean and to Cuba).

Picked Dog-fish, Pennant, British Zool. iii, p. 88, 1769, or ed. 1812, iii, p. 183.

Spinax, Duhamel, Pesch. iii, p. 299, pl. 20, fig. 5, 1777.

Squalus fernandinus, Molina, Hist. Chile, p. 194, 1788.

Aiguillat, Lacép. Hist. Poiss. i, p. 270, pl. 10, fig. 2, 1798 (Mediterranean).

Squalus acanthias, Cuv. Regne Anim. ii, p. 130, 1817 ; Richards. Faun. Bor. Amer. p. 291, 1836 ; Bonap. Faun. Ital. Pesc. iii, tab. 57, 1841 ; Parnell, Werner. Mem. vii, p. 420 ; Dekay, New York Faun. Fish. p. 359, pl. 64. fig. 210, 1842 ; Ayres, Boston Journ. Nat. Hist. iv., p. 288, 1844.

Acanthias vulgaris, Risso, Eur. Mérid. iii, p. 131, 1826 (Nice) ; Nilss. Skandinav. Faun. Fisk. p. 371, 1836 ; Kröy. Danm. Fisk. iii, p. 868, 1838 ; Müll. & Henle, Plag. p. 83, 1841 ; Yarrell, British Fish. 2nd ed. ii, p. 524, 1841, or 3rd ed. ii, p. 518, 1859 ; Schleg. Faun. Japon. Poiss. p. 304, pl. 135, 1850 (Japan) ; Gray, Chondropt. p. 70, 1851 (British coast ; Mediterranean ; Cape seas) ; Kessler, Bull. Soc. Nat. Mosc.

1859, ii, p. 473 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (S. Africa) ; Couch, Fish. British Isl. i, p. 49, pl. xi, 1861 ; Duméril, Elasmobr. p. 437, 1865 ; Bocage & Capello, Peix. Plag. p. 21, 1866 (Portugal) ; Günth. Cat. Fish. viii, p. 418, 1870 (Holland ; British coast ; Dalmatia ; Mediterranean ; Cape seas ; New Holland ; Australia) ; Vaill. Miss. Scient. Cap Horn, p. 5, 1888 ; Perugia, An. Mus. Civ. Génova, x, 1891, p. 608 (S. America) ; Herdm. & Daw. Fish. Irish Sea, p. 65, 1902 (British coasts).

Acanthias sp., Richards. Voy. *Erebus & Terror*, Fish. p. 44, pl. 28, figs. 1 and 2, 1846.

Acanthias americanus, Storer, Mem. Amer. Acad. ii, 1846, p. 506 (Massachusetts), Proc. Boston Soc. Nat. Hist. iii, 1848, p. 270, and Fish. Massachusetts, p. 232, pl. 38, fig. 1, 1867.

Spinax fernandezianus, Guichen in Gay's Chile, Zool. ii, p. 365, 1848.

Acanthias sucklii, Girard, Proc. Ac. Nat. Sc. Philad. 1854, p. 196 (Washington), and U.S. Pacific R.R. Exped. Fish. p. 368, 1858 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 54, 1896 (Aleutian Islands to Santa Barbara).

Squalus sucklii, Gill, Proc. Ac. Nat. Sc. Philad. 1862, p. 499; Everm. & Golds. Fish. Alaska, p. 228, 1907 (south-east Alaska).

Brain, Sander, Sitzsber. Ges. ntrf. Freund., Berlin, 1868, p. 26.

Echinorhinus, Blainville.

Echinorhinus, Blainville, Bull. Soc. Philom. 1816, p. 121 ; Günth. Cat. Fish. viii, p. 428, 1870.

Goniodus, Agassiz, Poiss. foss. iii, p. 183, 1836.

Echinorhinus spinosus, Gmel.

Le Bouclé, Brouss. Mem. Ac. Sc. 1780, p. 672 ; Lacép. Hist. Poiss. i, p. 283, pl. 3, fig. 2, 1798.

Squalus spinosus, Gmel. Linn. Syst. Nat. p. 1500, 1788 (The Ocean) ; Bl. Schn. Syst. Ichth. p. 136, 1801 ; Risso, Ichth. Nice, p. 42, 1810.

Squalus brucus, Bonnat. Encycl. 1788, p. 11 (The Ocean).

Scymnus spinosus, Cuv. Regne Anim. 1817 ; Cloquet, Dict. Sc. Nat. xxv, 1820, p. 434, pl. 28, fig. 2 ; Risso, Eur. Mérid. iii, p. 136, 1827.

Echinorhinus spinosus, Blainv. Bull. Soc. Philom. 1816, p. 121, and Faun. Franc. p. 66, 1828 ; Bonap. Faun. Ital. Pesc. 1840 ; Strickland, Ann. Nat. Hist. iv, 1840, p. 315 ; Müll. & Henle, Plag. p. 96, pl. 60 (skin), 1841 ; Yarrell, British Fish. 2nd ed. ii, p. 532, 1841, or 3rd ed. ii, p. 529, 1859 ;

Cocks, Ann & Mag. Nat. Hist. v, 1850, p. 71 ; Costa, Faun. Napol. Chondrott. tav. 16, 1850 ; Gray, Chondropt. p. 78, 1851 (Mediterranean ; Cape seas ; the ocean) ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Duméril, Elasmobr. p. 459, 1865 ; Günth. Cat. Fish. viii, p. 428, 1870 (Mediterranean ; English coast ; Cape of Good Hope) ; Jord. & Gilbert, Synops. p. 14, 1883 ; Parker, Trans. New Zealand Inst. xvi, 1884, p. 280 ; McCoy, Prodr. Zool. Vict. pl. cxliv, 1888 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 58, 1896 (Atlantic coasts of Europe and Africa ; a stray individual taken on Cape Cod) ; Regan, Ann. and Mag. Nat. Hist. (8) ii, 1898, p. 42 (From North Atlantic and Mediterranean to South Africa, Australia and New Zealand) ; Gilchr. Cat. Fish. 1902, p. 166 (South Africa) ; Herdm. & Daw. Fish. Irish Sea, p. 65, 1902 (British coasts) ; Jord. Tan. and Snyd. Cat. Fish. Japan, p. 23, 1913 (Atlantic coasts of Europe and Africa ; Cape Cod ; Japan).

Goniodus spinosus, Agass. Poiss. foss. iii, tab. E., fig. 13, 1836.

Echinorhinus obesus, Smith, Ill. Zool. S. Afr. Pisces, pl. 1, 1849 (Cape of Good Hope). Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa).

Spinous shark, Couch, Fish. British Isl. i, p. 54, pl. 12, 1861.

Squalus, Linn.

Squalus, Linn. Syst. Nat. ed. x, 1758, p. 233 ; Regan, Ann. Nat. Govt. Mus. i, 1906, p. 1.

Acanthias (part), Müll & Henle, Plag. 1841.

Squalus acutipinnis, Regan.

Acanthias blainvillei (part.), Günth. Cat. Fish. viii, p. 419, 1870 (Cape of Good Hope).

Squalus acutipinnis, Regan, Ann. Nat. Govt. Mus. i, 1908, pt. 3, p. 248, pl. xxxvii, and Col. Fish. Ibid p. 241 (Bird Islands); Ann. and Mag. Nat. Hist. (8) ii, 1908, p. 47 (South Africa ; Mauritius).

Pliotrema, Regan.

Pliotrema, Regan, Ann. Nat. Govt. Mus. i, 1906, pt. 1, p. 1, pl. 1.

Pliotrema warreni, Regan.

Regan, Ann. Nat. Govt. Mus. i, 1906, pt. 1, p. 1, pl. 1 (Natal ; False Bay) ; Col. Fish. 1908, p. 241, and Ann. and Mag. Nat. Hist. (8) ii, 1908, p. 57 (South Africa).

Family **PRISTIOPHORIDAE.**

Pristiophorus, Müll. & Henle.

Müll. & Henle, Plagiostomen, 1841 ; Günth. Cat. Fish. viii, p. 431, 1870.

Pristiophorus cirratus, Latham.

Pristis cirratus, Latham, Trans. Linn. Soc. ii, 1794, p. 281, tab. 26, figs. 5 and 27 ; Bl. Schn. p. 351, pl. 70, fig. 2, 1801 (cop. Latham).

Squalus anisodon, Lacép. Hist. Poiss. iv, p. 680, 1802 (New Holland).

Squalus tentaculatus, Shaw, Gen. Zool. v, 2, p. 359, 1803, and Nat. Misc. p. 630.

Pristiophorus cirratus, Müll & Henle, Plag. p. 98, 1841 ; ? Duméril, Elasmobr. p. 461, 1865 ; Waite, Mem. Austr. Mus. iv, 1899, p. 37 (common on coast of New South Wales) ; McCulloch, F.I.S. "Endeavour," Rep. Comm. Australia, pt. 1, 1911, p.9 (New South Wales 15-45 fms. ; N. of Goose Isld., Bass Strait).

A specimen has been identified by Dr. Boulenger from False Bay.

Sub-order **Batoidei.**

Family **PRISTIDAE.**

Pristis, Latham.

Pristis, Latham, Trans. Linn. Soc. ii, 1794, p. 276 ; Günth. Cat. Fish. viii, p. 436, 1870.

Pristobatus, Blainville, Journ. de Physique, 1816, p. 262

Myriosteon, Gray, Proc. Zool. Soc. 1864.

Pristis pectinatus, Latham.

(*Saw-fish.*)

Pristis pectinatus, Latham, Trans. Linn. Soc. 1794, ii, p. 278, pl. 26, fig. 2, rostrum (The ocean) ; Bl. Schn. Syst. Ichth. p. 351, pl. 70, fig. 1, 1801 (Havana) ; Risso, Ichth. Nice, p. 22, 1810, and Eur. Mérid. iii, p. 141, 1827 ; Blainv. Faun. Franc. p. 51, 1828 ; Müll. & Henle, Plag. p. 109, 1841 ; Owen, Odontogr. pl. 8, fig. 1, 1845 ; Gray, Chondropt. p. 90, 1851 (Atlantic ; West Indies ; Mexico ; Cape Seas ; Calcutta) ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860

(South Africa); Blyth, Journ. Asiatic Soc. Bengal, xxix, 1860, p. 36; Duméril, Elasmobr. p. 476, pl. 9, fig. 4, 1865; Günth. Cat. Fish. viii, p. 437, 1870 (West Indies; Mexico; Calcutta; Cape of Good Hope); Klunz. Synops. Fisch. Roth. Meer. p. 673, 1871 (Red Sea); Jord. & Gilbert, Synops. p. 875, 1883; Day, Fish. Ind. p. 811, 1888 (Red Sea, and through Indian Ocean); Jord. & Everm. Fish. N. and Mid. Amer. p. 60, 1896 (tropical seas, north to West Indies and Florida; abundant in Gulf of Mexico; ascending Lower Mississippi); Gilchr. Cat. Fish. 1902, p. 166 (South Africa).

Squalus scie, Lacép. Hist. Poiss. i, p. 286, pl. 8, 1798 (North Sea; coasts of Africa).

Pristis granulosa, Bl. Schn. Syst. Ichth. p. 352, 1801 (Havana).

Pristis mississippiensis, Rafinesque, Ichth. Ohio, p. 80, 1820 (Lower Mississippi).

Pristis megalodon, Duméril, Elasmobr. p. 476, pl. 9, fig. 4, 1865 (Cayenne).

Pristis acutirostris, Duméril, t.c.p. 479 (Martinique).

Pristis occa, Duméril, t.c.p. 479.

Pristis leptodon, Duméril, t.c.p. 480.

Pristis brevirostris, Duméril, t.c.p. 480.

Family **RHINOBATIDAE.**

Rhinobatus, Bl. Schn.

Rhinobatus, Bl. Schn. Syst. Ichth. p. 353, 1801; Günth. Cat. Fish. viii, p. 441. 1870; Jord. & Everm. Fish. N. and Mid. Amer. p. 61, 1896.

Lciobatus, Rafinesque, Caratteri di Alcuni Nuovi Generi, p. 16, 1810.

Syrrhina et *Rhinobatus*, Müll. & Henle, Plag. p. 113, 1841.

Glaucostegus, Bonap. Catalogo Métodico, p. 14, 1846.

Rhinobatus blochii, M. & H.

Rhinobatus (*Syrrhina*) *blochii*, Müll. & Henle, Plag. p. 115, pl. 37, fig. 1, 1841; Gray, Chondropt. p. 94, 1851 (Cape of Good Hope); Duméril, Elasmobr. p. 488, 1865.

Rhinobatus blochii, Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa); Günth. Cat. Fish. viii, p. 447, 1870 (Cape of Good Hope); Gilchr. Cat. Fish. 1902, p. 167 (South Africa); Regan, Col. Fish. 1908, p. 242 (Bird Islands; Durban Bay); Gilchr. & Thomp. Ann. S. Afr. Mus. xi, 1911, pt. ii, p. 55 (Natal).

Rhinobatus columnae, M. & H.

(*Zand-kruiper.*)

Rhinobatus s. *Squatinoraja*, Colonna, Phytobosanos, tab. 27 ; Willughby, p. 79, tab. D5, fig. 1, 1686.

Rhinobatus (*Syrrhina*) *columnæ*, Müll. & Henle, Plag. p. 113, 1841 ; Bonap. Faun. Ital. Pesc. 1841 (Italy) ; Costa, Faun. Regn. Nap. Chondrott. pl. 10, 1850 (Mediterranean) ; Gray, Chondropt. p. 94, 1851 (Mediterranean ; Sicily) ; Duméril, Elasmobr. p. 486, 1865.

Rhinobatus (*Syrrhina*) *annulatus*, Müll. & Henle, Plag. p. 116, 1841 ; Smith, Ill. Zool. S. Afr. Pisces, pl. 16, 1849 (Kowie ; Algoa Bay ; not found west of Cape Point) ; Gray, Chondropt. p. 94, 1851 (Cape seas) ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa), Duméril, t.c.p. 487 ; Kner, Novara Fische, p. 416, 1865 ; Pappe, Synops. p. 22, 1866 (rather scarce in Table Bay).

Raja rhinobatus, Gronov. Syst. ed. Gray, p. 10, 1854 (Mediterranean).

Rhinobatus (*Syrrhina*) *polyophthalmus*, Blkr. Verh. Bat. Gen. xxvi, N. Nalez. Japan, p. 129, 1854 (Nagasaki) ; Nat. Tijds. Ned. Ind. vi, p. 423, 1854 (Japan) ; Act. Soc. Sc. Indo-Neerl. iii, Japan iv, tab. 4, 1858 (Japan).

Rhinobatus columnæ, Günth. Cat. Fish. viii, p. 446, 1870 (Cape of Good Hope ; Port Natal ; Zanzibar) ; Steindr. Reise *Aurora*, p. 225, 1898 (Kobe) ; Gilchr. Cat. Fish. 1902, p. 167 (South Africa) ; Day, Fish. India, p. 811, 1888 ; Regan, Col. Fish. 1908, p. 242 (Bird Islands).

Rhinobatus polyophthalmus, Jord. & Fowler, Elasmobr. Fish. Fish. Japan, p. 646, 1903 (coasts of Japan) ; Jord. Tan. and Snyd. Cat. Fish. Japan, p. 24, 1913 (Tokyo to Nagasaki).

Rhinobatus obtusus, M. & H.

Rhinobatus obtusus, Müll. & Henle, Plag. p. 122, pl. 37, fig. 2, 1841 ; Gray, Chondropt. p. 97, 1851 (Cape seas ; India) ; Blyth, Journ. Asiatic Soc. Bengal, xxix, 1860, p. 37 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Duméril, Elasmobr. p. 493, 1865 ; Günth. Cat. Fish. viii, p. 443, 1870 (East Indies) ; Gilchr. Cat. Fish. 1902, p. 166 (South Africa).

? Rhinobatus halavi, Day, Fish. India, p. 731, pl. cxciii, fig. 4, 1888 (Mangalore).

Family **RAIIDAE.**

Raja (Artedi), Linn.

Raja (Artedi), Linn. Syst. Nat. ed. x, 1758, p. 231 ; Günth. Cat. Fish. viii, p. 455, 1870 ; Jord. & Everm. Fish. N. and Mid. Amer. p. 66, 1896.

Dipturus, Rafinesque, Caratteri di Alcuni Nuovi Generi, p. 16, 1810.

Platopterus, Rafinesque, Analyse de la Nature, p. 93, 1815.

Dasybatus, Blainville, Journ. de Physique, 1816, p. 260.

Propterygia, Otto, Nova acta Acad. Caes. Leop. Carol. Nat. curios, 1824, p. 111 (monstrous example, fins not adnate to head).

Laeviraja, Bonap. Faun. Ital. Pesc. xxv, p. 130, 1839.

Uraptera, Müll. & Henle, Plag. p. 155, 1841 (Species without caudal fin).

Batis, Bonap. Cat. Métodico, p. 12, 1846 (no description).

Malacorhinus, Garman, Bull. Mus. Comp. Zool. xi, 1881, p. 236 (species with imperfect rostral cartilage).

Raia, various authors, change of spelling.

Raia batis, Linn.

(*The Common Skate.*)

Raja, sp. No. 9, Artedi, Gen. p. 73, Synon. p. 102, 1738.

Raja batis, Linn. Syst. Nat. ed. x, i, p. 395, 1758 ; Bl. Ichth. taf. 79, 1797 ; Bl. Schn. Syst. Ichth. p. 369, 1801 ; Turton, Brit. Faun. p. 110, 1807 ; Risso. Ichth. Nice, p. 3, 1810 ; Holberg, Göt. Vet. N. Handl. 1822, p. 21 ; Fleming, British An. p. 171, 1828 ; Faber, Fische Islds. p. 33, 1829 ; Jenyns, Man. p. 510, 1835 ; Nilss. Skandinav, Faun. Fisk. p. 738, 1836 ; Fries, Vet. Ak. Handl. 1838, p. 158, pl. 3, fig. 6 ; Kröy. Danmarke Fisk. iii, p. 978, 1838 ; Müll. & Henle, Plagiost. p. 146, 1841 ; Yarrell, Brit. Fish. 2nd ed. 1841, 3rd ed. 1859, ii, p. 561 ; Malm, Oefvers. Vet. Ak. Förh. 1857, p. 193 ; Günth. Cat. Fish. viii, p. 463, 1870 (German Ocean ; Firth of Forth ; English coast ; Holland) ; Herdm. & Daw. Fish. Irish Sea, p. 66, 1902 (common all round British Islands).

Skate, Pennant, British Zool. iii, p. 72, pl. 9, 1769 and ed. 1812, iii, p. 111, pl. 11.

Raja intermedia, Parnell, Proc. Royal Soc. Edinb. 1837, p. 166 and Trans. Roy. Soc. Edinb. 1839, xiv, p. 429, pl. 6, and Werner. Mem. vii, p. 429, pl. 40 ; Yarrell, British Fish. l.c. p. 558 ; McCoy, Ann. and Mag. Nat. Hist. 1841, vi, p. 406 (not Couch).

Raja leiobatos, Gronov. Syst. ed. Gray, p. 10, 1854 (North Sea).
Laeviraja macrorhynchus, Couch, Fish. British Isl. i, p. 561, 1863.
Development : Wynan, Mem. Amer. Ac. 1864, ix, p. 31, or Ann. and Mag. Nat. Hist. 1864, xiv, p. 399.

Note.—Raja batis has also been identified by Dr. Boulenger, from Buffels Bay, off Cape Point Lighthouse, 34 fms.

Raja capensis, M. & H.

Raja capensis, Müll. & Henle, Plag. p. 151, 1841 ; Gray, Chondropt. p. 112, 1851 (Cape) ; Blkr. Visch. v.d. Kaap, p. 58, name only, 1860 (South Africa) ; Duméril, Elasmobr. p. 540, 1865 ; Kner, Novara, Fische, p. 419, 1865 (Cape of Good Hope) ; Capello, Jorn. Ac. Sci. Lisbon, 1869, p. 151 ; Günth. Cat. Fish. viii, p. 455, 1870 (Cape of Good Hope) ; Gilchr. Cat. Fish. 1902, p. 168 (South Africa).

Raja maculata, Montagu.

(*Spotted Ray ; Skate ; Rog.*)

Fuller Ray, Pennant, British Zool, iii, p. 86, 1769, or ed. 1812, iii, p. 116.
Raja rubus, Turton, British Faun. p. 111, 1807 ; Donovan, British Fish. i, pl. 20, 1808.
Raja miraletus, Turton l.c. ; Donovan t.c. v, pl. 103 ; Jenyns, Man. p. 518. 1835 ; Yarrell, British Fish. 2nd ed. 1841, 3rd ed. 1859, ii, p. 570.
Raja maculatus, Montagu, Wern. Mem. ii, p. 426 ; Jenyns, Man. p. 514, 1835 ; Parnell, Wern. Mem. vii, p. 434, tab. 42 ; Thompson, Nat. Hist. Ireland, iii, p. 260, 1856 (Irish coast) ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Pappe, Synops. p. 23, 2nd ed. 1866 (Cape of Good Hope) ; Günth. Cat. Fish. viii, p. 458, 1870 (British coast ; Guernsey ; Madeira) ; Day, British Fish. ii, p. 345, pl. clxxii, 1884 ; Herdm. & Daw. Fish, Irish Sea, p. 67, 1902 (Dee ; Mersey ; Menai Straits, etc.) ; Gilchr. Cat. Fish. 1902, p. 168 (South Africa).
Raja microcellata, Montagu, Werner. Mem. ii, p. 430 ; Fleming, British Anim. p. 171, 1828 ; Jenyns, Man. p. 515, 1835 (British coasts) ; McCoy, Ann. Nat. Hist. vi, 1841, p. 407 ; Yarrell, t.c.p. 567 ; Gray, Chondropt. p. 109, 1851 (English coast).
Spotted Ray, Couch, Fish. British Isl. i, p. 104, pl. 24, 1861.
Painted Ray, Couch, t.c.p. 107, pl. 25.
Homelyn Ray, Günth. Cat. Fish. viii, p. 458, 1870.

Raja marginata, Lacép.

Raja marginata, Lacép. Hist. Poiss. v, p. 663, pl. 20, fig. 2, 1803 (Dieppe ; Liverpool ; Brighton) ; Risso, Eur. Mérid. iii, p. 148, 1827 (Europe) ; Blainv. Faun. Franc. p. 19, pl. 3, fig. 2, 1828 ; Fleming, British An. p. 172, 1828 ; Jenyns, Man. p. 512, 1835 ; Bonap. Faun. Ital. Pesc. fasc. vi, 19, t. 3, fig. 2, 1840 (Italy) ; Müll. & Henle, Plag. p. 140, 1841 ; Yarrell, British Fish. 2nd ed. 1841, or 3rd ed. 1859, ii, p. 564 ; Gray, Chondropt. p. 108, 1851 (North Sea) ; Couch, Fish. British Isl. i, p. 110, pl. 26, 1861 ; Duméril, Elasmobr. p. 568, 1865 ; Günth. Cat. Fish. viii, p. 465, 1870 (Coasts of Europe ; English coast) ; Regan, Col. Fish. 1908, p. 242 (Bird Islands).

Raja rostrata, Lacep. t.c. iv, p. 672, 1802 (Rouen).

Raja rostellata, Risso, Ichth. Nice, p. 8, pls. 1 and 2, 1810 (Nice), and Eur. Mérid. iii, p. 148, 1827 (Europe).

Raja oxyrhynchus (*Burton Skate*), Couch, t.c.p. 97, pl. 21 (adult male. Not synon.)

Raja miraletus, Linn.

Raja miraletus, Linn. Syst. Nat. ed. x, i, p. 396, 1758 ; Brunn. Ichth. Massil. p. 2, 1768 (Mediterranean) ; Lacép. Hist. Poiss. i, p. 75, 1798 ; Risso, Ichth. Nice, p. 4, 1810, and Eur. Mérid. iii, p. 149, 1827 ; Bonap. Faun. Ital. Pesc. 1841 ; Müll. & Henle, Plag. p. 141, 1841 ; Couch, Fish. British Isl. i, p. 112, pl. xxvii, 1862 ; Duméril, Elasmobr. p. 548, 1865 ; Günth. Cat. Fish. viii, p. 460, 1870 (coasts of southern Europe) ; Herdm. & Daw. Fish. Irish Sea, p. 66, 1902.

Raja biocularis, Geoffr. St.-Hil. Descr. Egypte, Poiss. pl. 27, fig. 2, 1813.

Raja oculata, Risso, Eur. Mérid. iii, p. 149, 1827.

? Raja quadrimaculata, Bonap. Faun. Ital. Pesce. 1841.

Note.—This species has also been identified by Dr. Boulenger, from off Cape St. Blaize, 36 fms.

Raja ocellifera, Regan.

Regan, Ann. Natal Govt. Mus. i, pt. 1, p. 2, pl. ii, 1906 (Algoa Bay ; Natal), and Col. Fish. 1908, p. 242 (Bird Islands).

Raja rhizacanthus, Regan.

Regan, Ann. Natal Govt. Mus. i, pt. 1, p. 3, pl. iii, 1906 (Natal coast), and Col. Fish. 1908, p. 242 (Bird Islands).

Raja smithii, M. & H.

Müll. & Henle, Plag. p. 150, pl. 48, fig. 1, 1841; Gray, Chondropt. p. 112, 1851 (South Africa); Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa); Duméril, Elasmobr. p. 553, 1865; Günth. Cat. Fish. viii, p. 467, 1870 (South Africa; Bosphorous ?); Gilchr. Cat. Fish. 1902, p. 168 (South Africa).

Family **TORPEDINIDAE.**

Torpedo, Duméril.

Torpedo, Duméril, Zool. Analyt. 1806, p. 102; Günth. Cat. Fish. viii, p. 448, 1870.

Narcobatis, Blainville, Journ. Phys. 1816, p. 262.

Tetronarce, Gill, Ann. Lyc. Nat. Hist. New York, 1861, viii, p. 387; Jord. & Everm. Fish. N. and Mid. America, p. 77, 1896.

Torpedo hebetans, Lowe.

Torpedo hebetans, Lowe, Trans. Zool. Soc. ii, 1841, p. 195; Günth. Cat. Fish. viii, p. 449, 1870 (Plymouth; Madeira; Mediterranean; Atlantic).

Torpedo nobiliana, Bonap. Faun. Ital. Pesc. 1841; Müll. & Henle, Plag. p. 128, 1841; Yarrell, British Fish. 2nd ed ii. p. 546, 1841, or 3rd ed. ii, p. 544, 1859; Duméril, Elasmobr. p. 512, 1865.

Torpedo walshii, Thompson, Ann. Nat. Hist. 1840, v, p. 292, or Nat. Hist. Ireland, iv, p. 256, 1856.

? Torpedo emarginata, McCoy, Ann. Nat. Hist. 1841, vi, p. 407.

Torpedo nigra, Guichen. Explor. Algérie, Poiss. p. 131, pl. 8, 1850.

Torpedo, Couch, Fish. British Isl. i, pl. 30, 1862.

Note.—This species has also been identified by Dr. Boulenger from off Cape St. Blaize, 31 fms.

Torpedo marmorata, Risso.

Narce or Torpedo, Bellon. De Aquat. i, p. 90, 1553 (Mediterranean).

Torpedo tertia et quarta, Rondel, p. 363, 1555.

Torpille, Réaumur, Mem. Ac. Sc. Paris, 1714, p. 344, tab. 12, fig. 1, and tab. 13, fig. 2; Duhamel, Pesches, ii, p. 286, tab. 13, 1777.

Narcacion, Klein, Pisc. Miss. iii, p. 32, Nos. 3 and 4, 1749.

Raia torpedo, Linn. Syst. Nat. ed. x, 1758, i, p. 395 ; Brünn. Ichth. Massil. 1768 (Marseilles) ; Turton, British Faun. p. 10, 1807 ; Donovan, British Fish. iii, p. 53, 1808.
Electric Ray, Pennant, British Zool. iii, p. 78, pl. 10, 1769, or ed. 1812, iii, p. 118, pl. 12.
Torpedo, Walsh, Phil. Trans. 1773, p. 461, tab. 19 ; Hunter, ibid, p. 481, tab. 20 ; Pringle, ibid, 1774 ; Cavendish, ibid, 1776, p. 196.
Torpedo marmorata, Risso, Ichth. Nice, p. 20, pl. 3, fig. 4, 1810, and Eur. Mérid. iii, p. 143, fig. 9, 1827 (Mediterranean) ; Olfers, Torped. p. 14, 1831 (Brazil) ; Henle, Narcine, p. 30, 1834 ; Müll. & Henle, Plag. p. 128, 1841 ; Yarrell, British Fish. 2nd ed. ii, p. 542, 1841, or 3rd ed. ii, p. 559, 1859 ; Gray, Chondropt. p. 100, 1851 (Mediterranean) ; Duméril, Rev. Zool. 1852, p. 236, or Elasmobr. p. 508, 1865 : Günth. Cat. Fish. viii, p. 451, 1870 (Nice ; Mediterranean ; Madeira ; Port Natal) ; Gilchr. Cat. Fish. 1902, p. 167 (South Africa) ; Regan, Col. Fish. 1908, p. 242 (Algoa Bay ; Bird Islands ; Congella).
Torpedo galvani, Risso, Ichth. Nice, p. 21, pl. 3, fig. 5, 1810, or Eur. Mérid. iii, p. 144, 1827 ; Bonap. Faun. Ital. Pesc. 1840.
Torpedo vulgaris, Fleming, British Anim. p. 169, 1828.
Torpedo diversicolor, Davy, Phil. Trans. 1834, ii, p. 550.
Torpedo trepidans, Val. in Webb & Berth. Iles Canar. Poiss. p. 101, 1836 (Canary Islands) ; Duméril, Rev. Zool. 1852, p. 238, or Elasmobr. p. 511, 1865.
Torpedo hebetans, Valenc. l.c.p. 23 (not Lowe).
Torpedo picta, Lowe, Proc. Zool. Soc. 1843, p. 93.
Narcacion polleni, Blkr. Ned. Tijds. Dierk. iii, p. 171, 1866 (Ile de la Réunion).

Torpedo smithii, Günth.

Günth. Cat. Fish. viii, p. 451, 1870 (South Africa) ; Gilch. Cat. Fish. 1902, p. 167 (South Africa).

Narcine, Henle.

Narcine, Henle, Ueber Narcine, p. 31, 1834 ; Günth. viii, p. 452, 1870.
Cyclonarce, Gill, Ann. Lyc. Nat. Hist. New York, 1861, p. 387.
Gonionarce, Gill, l.c.

Narcine brasiliensis, Olfers.

Raja sp., Gronov. Zoophyl. No. 358, tab. 9, fig. 3, 1763.
? Torpedo ocellata, Quoy & Gaim. Voy. Uran. Poiss. p. 199, 1824.

Torpedo brasiliensis, Olfers, Torped. p. 19, tab. 2, fig. 4, 1831 (Brazil).

Torpedo bancroftii, Griffith, Anim. Kingd. x, p. 649, pl. 34, 1834 (Jamaica).

Narcine brasiliensis, Henle, Narcine, p. 31, tab. 1, figs. 1 and 2, 1834 ; Müll. & Henle, Plag. p. 129, 1841 ; Gray, Chondropt. p. 102, 1851 (West Indies ; Para) ; Duméril, Rev. Zool. 1852, p. 272, or Elasmobr. p. 514, 1865 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Kner, Novara, Fische, p. 418, 1865 ; Günth. Cat. Fish. viii, p. 453, 1870 (Atlantic coasts of tropical America, entering fresh waters ; Para ; Caribbean Sea ; Cuba ; Jamaica ; Cape of Good Hope); Jord. & Everm. Proc. U.S. Nat. Mus. 1886, p. 472, and Fish. N. and Mid. Amer. p. 78, 1896 (West Indies and Brazil, occasionally northwards to Key West and Pensacola) ; Gilchr. Cat. Fish. 1902, p. 167 (South Africa).

Narcine nigra, Duméril, Rev. Zool. 1852, p. 272 (Brazil).

Torpedo pictus, Gronov. Syst. ed. Gray, p. 13, 1854 (Antilles).

Narcine brasiliensis corallina, Garman, Bull. Mus. Comp. Zool. xi, 1881, p. 234 (Florida) ; Jord. & Gilbert, Synops. p. 877, 1883.

Narcine umbrosa, Jordan, Proc. U.S. Nat. Mus. 1884, p. 105 (Key West).

Astrape, Müll. & Henle.

Astrape, Müll. & Henle, Plag. p. 130, 1841 ; Günth. Cat. Fish. viii, p. 454, 1870.

Astrape capensis, Gmel.

Raja sp. Gronov. Zoophyl. No. 152, 1763.

Raja capensis, Gmel. Linn. Syst. Nat. i, p. 1512, 1793 ; Bl. Schn. Syst. Ichth. p. 360, 1801.

Torpedo capensis, Olfers, Torped. p. 23, 1831; Gronov. Syst. ed. Gray, p. 13, 1854 (Cape of Good Hope).

Narcine capensis, Henle, Narcine, p. 36, pl. 3, fig. 1, 1834.

Astrape capensis, Müll. & Henle, Plag. p. 130, 1841 ; Gray, Chondropt. p. 103, 1851 (Cape of Good Hope) ; Duméril, Rev. Zool. 1852, p. 280, and Elasmobr. p. 522, 1865 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Kner, Novara, Fische, p. 419, 1865 (Cape of Good Hope) ; Günth. Cat. Fish. viii, p. 454, 1870 (Cape of Good Hope ; Madagascar) ; Gilchr. Cat. Fish. 1902, p. 168 (South Africa) ; Regan, Col. Fish. 1908, p. 242 (Bird Islands).

Family **DASYATIDAE.**

Dasyatis, Rafinesque.

Dasybatus, Klein, 1742 (pre-Linnaean).
Dasyatis, Rafinesque, Caratteri di Alcuni Nuovi Generi, p. 16, 1810 ; Jord. & Everm. Fish. N. and Mid. America, p. 82, 1896.
Uroxis, Rafinesque, Indice d'Ittiol. Siciliana, p. 61, 1810.
Trigonobatus, Blainville, Journ. Phys. 1816. p. 261.
Trygon (Adanson) Cuv. Regne Anim. ed. i, p. 136, 1817 ; Günth. Cat. Fish. viii, p. 472, 1870.
Hemitrygon, Müll. & Henle, Mag. Nat. Hist. 1837, p. 90.
Himantura, Müll. & Henle, Wiegm. Archiv. 1837, p. 400.
Pastinaca, Swainson, Classn. Anim. p. 319, 1839 ; Dekay, New York Faun. Fish. p. 373, 1842.
Anacanthus, Ehrenberg, in Swainson, l.c.
Dasybatis, Garman, in Jord. & Gilbert, Synopsis, p. 65, 1883.

Dasyatis pastinaca, Linn.

(*Sting-Ray ; Pijl-staart.*)

Pastinaca marina, Bellon. De Aquat. p. 94, 1553 (Mediterranean) ; Rondel. De Pisc. p. 331, 1554 ; Salvian. p. 144, tab. 49, 1554 (Italy) ; Willughby, p. 67, tab. C3, 1686.
Raja sp. Nos. 3 *and* 4, Artedi, Gen. p. 71, Synon. p. 100, 1738 ; Gronov. Mus. Ichth. i, p. 64, No. 141, 1756.
Raja pastinaca, Linn. Syst. Nat. ed. x, i, p. 396, 1758 ; Bl. Ichth. taf. 82, 1797 ; Bl. Schn. Syst. Ichth. p. 360, 1801 ; Turton, British Faun. p. 112, 1807 ; Donovan, British Fish. v., pl. 99, 1808 ; Risso, Ichth. Nice, p. 10, 1810.
The Sting-Ray, Pennant, British Zool. iii, p. 83, 1769, or ed. 1812, iii, p. 125.
Raja sayi, Lesueur, Journ. Ac. Nat. Sc. Philad. 1817, i, p.42.
Trygon pastinaca, Cuv. Regne Anim. 1817 ; Fleming, British An. p. 170, 1828 ; Jenyns, Man. p. 518, 1835 ; Nilss. Skandinav. Faun. Fisk. p. 741, 1836; Kröy. Danm. Fisk. iii, p. 1018, 1838 ; Müll. & Henle, Plag. p. 161, 1841 ; Bonap. Faun. Ital. Pesc. fasc. vi, 1841 ; Yarrell, British Fish. 2nd ed. ii, p. 588, 1841, or 3rd ed. ii, p. 591, 1859 ; Gray, Chondropt. p. 118, 1851 (European Seas) ; Kessler, Bull. Soc. Nat. Moscou, 1859, ii, p. 474 ; Parnell, Werner. Mem. vii, p. 440, pl. 43 ; Blkr. Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Couch, Fish. British Isl. i, p. 130, pl. 31, 1865 ; Duméril, Elasmobr. p. 600, 1865 ; Günth. Cat. Fish. viii, p. 478, 1870 (Plymouth ; North America ; Lanzarote ; Jamaica ; West

Indies; New Orleans, British Guiana; Bahia; Amoy; Japan), and "Challenger" Shore Fishes, pp. 37 and 63, 1880 (Arapura Sea; Yokohama); Day, British Fish. ii, p. 350, pl. clxxv, 1884; Smitt, Scandinavian Fish. p. 1098, pls. 313 and 314, 1895 (Cape of Good Hope); Herdmn. & Daw. Fish. Irish Sea, p. 68, 1902 (coast of Ireland); Gilchr. Cat. Fish. 1902, p. 168 (South Africa).

Trygon vulgaris, Risso, Eur. Mérid. iii, p. 160, 1827 (Mediterranean).

Trygon lymna, Geoff. St. Hil., Desc. Egypt. Poiss. p. 219, pl. 27, fig. 1, 1827.

Trygonobatus pastinaca, Blain. Faun. Franc. p. 35, pl. 6, figs. 1 and 2, 1828.

Trygon akajei, Müll. & Henle, Plag. p. 165, taf. 53, 1841 (Nagasaki); Schleg. Faun. Japon, Poiss. p. 308, 1850 (Nagasaki); Blkr. Act. Soc. Sc. Indo-Neerl. iii, Japan iv, p. 44, 1858; Duméril, Elasmobr. p. 604, 1865 (Nagasaki).

Trygon sayi, Müll. & Henle, t.c.p. 166, 1841; Duméril, t.c.p. 603.

Pastinaca laevis, Gronov. Syst. ed. Gray, p, 11, 1854 (Europe; America).

Myliobatis sayi, Storer, Mem. Amer. Acad. ii, p. 514.

Dasyatis akajei, Jord. & Fowler, Elasmobr. Fish. Japan, p. 659, 1903 (coasts of Japan, common southwards in sandy bays); Jord. Tan. & Snyd. Cat. Fish. Japan, p. 28, 1913 (coasts of Japan, very common).

Dasyatis purpurea, M. & H.

Dasyatis purpurea, Müll. & Henle, Plag. p. 160, taf. 51, 1841 (South Africa; known from a drawing); Gray, Chondropt. p. 117, 1851 (Cape seas); Blkr. Visch. v.d. Kaap, p. 58. Name only, 1860 (South Africa); Günth. Cat. Fish. viii, p. 472, 1870 (South Africa; from a drawing).

Dasyatis schreineri, Gilchr.

Trygon schreineri, Gilchr. Trans. Royal Soc. S. Afr. iii, 1913, pt. 1, p. 33 and figure. (St. James, False Bay.)

Dasyatis uarnak, Forsk.

Raja uarnak, Forsk. Descr. anim. p. 18, 1775. (Red Sea.)

Trygon russellii, Gray & Hardw. Ill. Ind. Zool. c. fig., 1834.

Pastinacus uarnak, Rüpp. N.W. Fische, p. 69, pl. 19, figs. *2a* and *2b*, 1838. (Red Sea.)

Trygon uarnak, Müll. & Henle, Plag. p. 158, 1841 ; Richards. Ichth. China, p. 197, 1846 ; Cantor, Malay. Fish. p. 423, 1849 ; Gray, Chondropt. p. 116, 1851 (Indian and Red Seas) ; Blkr. Verh. Bat. Gen. xxiv, Plag. p. 69, 1852 (Indian Archipelago), and Visch. v.d. Kaap, p. 58, Name only, 1860 (South Africa) ; Blyth, Journ. Asiatic Soc. Bengal, 1860, p. 42 ; Duméril, Elasmobr. p. 585, 1865 ; Day, Fish. Malabar, p. 277, 1865, and Fish. Ind. p. 737, pl. cxciv, fig. 1, 1878 (Red Sea ; seas and estuaries of India to Malay Archipelago and China ; Cape of Good Hope) ; Günth. Fish. Zanz. p. 143, 1866 (Zanzibar), and Cat. Fish. viii, p. 473, 1870 (Red Sea ; Zanzibar ; Seychelles ; Madras ; Penang ; East Indian Archipelago) ; Klunz. Fisch. Roth. Meer. p. 679, 1871 (Red Sea) ; Gilchr. Cat. Fish. 1902, p. 169 (South Africa) ; Steindr. Fisch. Süd-arab. Sok. p. 38, 1902 (Sokótra).

Trygon variegatus, McClell. Calc. Journ. Nat. Hist. 1841, i, p. 60, pl. 2, fig. 2 ; Blyth, Journ. Asi. Soc. Bengal, 1860, p. 43.

Trygon gerrardi, Gray, Chondropt. p. 116, 1851 (Indian Ocean) ; Günth. Cat. Fish. viii, p. 474 (young) 1870 ; Jord. & Fowler, Elasmobr. Fish. Japan, p. 661, 1903 (India ; East Indies).

Trygon uarnacoides, Blkr. Verh. Bat. Gen. xxiv, Plag. p. 72, 1852 (Indian Archipelago), or Nat. Tijds. Ned. Ind. iii, p. 738, 1852 (Banka) ; Duméril. Elasmobr. p. 586, 1865.

Trygon undulatus, Blkr. Verh. Bat. Gen. xxiv, Plag. p. 70, 1852 (Indian Archipelago) ; Duméril, t.c.p. 586.

Trygon pareh, Blkr. l.c.p. 72 (Indian Archipelago), or Nat. Tijds. Ned. Ind. v, 1853, p. 461 (Borneo) ; Duméril, t.c.p. 590.

Trygon macrurus, Blkr. Verh. Bat. Gen. xxiv, Plag. p. 74 (Java ; Sumatra) ; Duméril, t.c.p. 588.

Trygon pastinacoides, Blkr. l.c.p. 75 (Indian Archipelago).

Trygon ellioti, Blyth, Journ. Asi. Soc. Bengal, 1860, p. 41.

Dasybatis uarnak, Regan, Col. Fish. 1908, p. 242 (Durban Bay).

Family **MYLIOBATIDAE.**

Myliobatis, Duméril.

Myliobatis, Duméril in Cuv. Regne Anim. ed. 1, ii, p. 137, 1817 ; Günth. Cat. Fish. viii, p. 488, 1870 ; Jord. & Everm. Fish. N. and Mid. America, p. 89, 1896.

Holorhynus, Gill, Proc. Ac. Nat. Sc. Philad. 1862, p. 331.

Myliobatis aquila, Linn

Aquila marina, Bellon. De Aquat. pp. 96 and 97, 1553 (Mediterranean) ; Salvian. p. 146, 1554 (Italy) ; Jonston, De Pisc. pl. 9, fig. 9, 1657 ; Willughby, p. 64, tab. C2, 1686.

Pastinaceæ species 2da, Rondel. p. 338, 1555

Aquilone, Columna, Aquat. et Terrestr. anim. obs. pp. i, ii.

Raja, sp. No. 5, Artedi, Gen. p. 72, Synon. p. 100, 1738.

Raja aquila, Linn. Syst. Nat. ed. x, i, p. 396, 1758 · Brünn. Pisc. Massil. p. 3, 1768 (Marseilles) ; Duhamel, Pesch. iii, sect. ix, p. 283, pl. 10, 1777 ; Bl. Ichth. taf. 81, 1794 ; Bl. Schn. Syst. Ichth. p. 360, 1801 ; Risso, Ichth. Nice, p. 9, 1810.

Whip-Ray, Pennant, British Zool. iii, p. 88, 1769, and ed. 1812, iii, p. 128 (British coast) ; Jenyns, Man. p. 519, 1835.

Myliobatis aquila, Cuv. Regne anim. 1817 ; Risso, Eur. Mérid. iii, p. 162, 1827 ; Müll. & Henle, Plag. p. 176, 1841; Yarrell, British Fish. 2nd ed. ii, p. 591, 1841, and 3rd ed. ii, p. 595, 1859 ; Gray, Chondropt. p. 128, 1851 (Madeira) ; Bikr. Visch. v.d. Kaap, p. 59, Name only, 1860 (South Africa) ; Couch, Fish. British Isl. i, p. 135, pl. 32, 1865 ; Duméril, Elasmobr. p. 634, 1865 ; Günth. Cat. Fish. viii, p. 489, 1870 (English and Scottish coasts ; Madeira ; Sydney), and " Challenger " Shore Fishes, p. 63, 1880 (Yokohama) ; Day, British Fish. p. 353, pl. clxxvi, 1884 ; Smith, Scandinavian Fish. p. 1095, pl. 311, 1895 ; Gilchr. Cat. Fish. 1902, p. 169 (South Africa) ; Regan, Col. Fish. 1908, p. 242, (Bird Islands).

Pastinaca aquila, Gronov. Syst. ed. Gray, p. 12, 1854 (Mediterranean).

Order **HOLOCEPHALI.**

Family **CHIMAERIDAE.**

Chimaera, Linn.

Chimaera sp. Linn. Syst. Nat. ed. x, p. 236, 1758.
Chimaera, Günth. Cat. Fish. viii, p. 349, 1870.

Chimaera monstrosa, Linn.

Simia marina, Gesner, De Aquat. p. 877, 1560 ; Aldrov. p. 405, 1638 ; Jonston, p. 16, tab. 7, fig. 6, 1649.

Centrina, Aldrov. pp. 402 and 403, 1638.

Galeus acanthias, Clusii exot. (copied by Jonston, tab. 45, fig. 2, 1649, and Willughby, p. 57, tab. B9, fig. 6, 1686).

Chimaera monstrosa, Linn. Ad. Fried. i, p. 53. pl. 25, 1754, and Syst. Nat. ed. x, p. 236, 1758 (Atlantic Ocean); Gunner., Drondhj. Selsk. Skr. ii, 1763, p. 270, pls. 5 and 6; Bl. Ichth. iv, p. 69, tab. 124, 1797; Lacép. Hist. Poiss. i, p. 392, pl. 19, fig. 1, 1798 (Northern Ocean, in deep water); Bl. Schn. Syst. Ichth. p. 349, 1801; Turton, British Faun. p. 114, 1807; Donovan, British Fish. v, pl. iii, 1808; Faber, Fische Isl. p. 41, 1829; Fleming, British An. p. 172, 1828; Jenyns, Man. p. 494, 1835; Kröy. Danm. Fisk. iii, p. 783, 1838; Benn. in Beechey's Voy. Fish. p. 72, pl. 23, fig. 3, 1839; Bonap. Faun. Ital. Pesc. 1841; Yarrell, British Fish. 2nd ed. ii, p. 483, 1841, and 3rd ed. ii, p. 464, 1859; Costa, Faun. Napol. Chondr. Chim. pp. 1-47, pl. 1-7 (anatomy) 1850; Schleg. Faun. Japon. Poiss. p. 300, pl. 132, 1850; Gray, Chondropt. p. 21, 1851 (North Sea); Gaimard, Voy. Isl. et Groenl. Zool. pl. 20, 1851; Blkr. Nat. Tijds. Ned. Ind. iii, p. 309, 1852 (Amboina & Ceram); Duméril, Elasmobr. p. 686, pl. 13, figs. 3 and 4, and pl. 14, fig. 1, 1865 (Cape of Good Hope); Poey, Synops. p. 445, 1868 (Matanzas, Cuba); Günth. Cat. Fish. viii, p. 349, 1870 (Jutland; N. coast Norway; Shetland Isles; Lisbon; Nice), and Deep-sea Fishes "Challenger," Zool. xxii, p. 12, 1887 (Faeroe Channel, 505-550 fms.); Smitt, Scandinavian Fish. p. 1079, pl. xlvi, figs. 2 and 3, 1895; Jord. & Everm. Fish. N. and Mid. Amer. p. 95, 1896 (Deep waters off coast of Europe); Gilchr. Cat. Fish. 1902, p. 162 (South Africa).

Chimaera argentea, Ascanius, Icones, pl. xv, 1775.

Chimaera borealis, Shaw, Gen. Zool. v, 2, p. 365, pl. 157, 1804 (after Linnaeus).

Northern chimaera, Pennant, British Zool. ed. 1812, iii, p. 159; Couch, Fish. British Isl. i, p. 145, pl. 34, 1865.

Chimaera mediterranea, Risso, Eur. Mérid. iii, p. 168, 1827 (Nice).

Chimaera cristata, Faber, Fische Isl. p. 45, 1829 (Iceland).

Callorhynchus centrina, Gronov. Syst. ed. Gray, p. 15, 1854 (Atlantic).

Callorhynchus atlanticus, Gronov. t.c.p. 16 (Atlantic).

Callorhynchus, Gronov.

Callorhynchus, Gronov. Mus. Ichth. i, p. 59, 1754; Günth. Cat. Fish. viii, p. 351, 1870.

Callorhynchus antarcticus, Lacép.

(*Josep ; Dodskop ; Southern Chimaera.*)

Accipenser No. 10, Klein, Pisc. Miss. iii, p. 16, 1749.

Callorhynchus sp., Gronov. Mus. Ichth. i, p. 59, No. 130, 1754, and Zoophyl. No. 141, tab. 4, figs. 1 and 2, 1763.

Chimaera callorhynchus, Linn. Syst. Nat. ed. x, i, p. 402, 1758 ; Bonnat. Tab. Encycl. Mét. Ichthyol. p. 14, 1799.

Chimaera antarctica, Lacép. Hist. Poiss. i, p. 400, pl. 12, fig. 2, 1798 (coasts of Chili and New Holland).

Chimaera australis, Shaw, Gen. Zool. v. 2, p. 368, pls. 158 and 158*, 1804.

Callorhynchus antarcticus, Cuv. Regne anim. 1817 ; Gay, Chile, Zool. ii, p. 358, 1848 ; Blkr. Visch. v.d. Kaap, p. 57, Name only, 1860 (South Africa) ; Duméril, Elasmobr. p. 693, pl. 13 (head) 1865 (Cape of Good Hope) ; Günth. Cat. Fish. viii, p. 351, 1870 (Cape of Good Hope ; Australia ; New Zealand ; Chili) ; Vaill. Miss. Scient. Cap Horn, Poiss. p. 16, 1888 ; Phil. An Mus. Nac. Chile, p. 9, tab. iv, 1892 ; Steindr. & Spengel, Zool. Jahrb. Supp. iv, 2nd Heft, p. 331, 1898 (Chili) ; Smitt, Poiss. Nordensk. Exped. Scient. Terre de Fue, p. 128, pl. xi, 1898 ; Gilchr. Cat. Fish. 1902, p. 162 (South Africa) ; Regan, Col. Fish. 1908, p. 242 (Bird Islands).

Callorhynchus milii, Bory St. Vincent, Dict. Class. Nat. Hist. iii, p. 62, pl. 5, 1823.

Callorhynchus smythii, Benn. in Beechey's Voy. Fish. p. 75, pl. 22, fig. 3 (young ; bad), 1839.

Callorhynchus tasmanius, Richards. Trans. Zool. Soc. iii, p. 696, 1841.

Callorhynchus antarctica, Gray, Chondropt. p. 22, 1851 (Australia).

Callorhynchus australis, Owen, Osteol. Cat. i, p. 89, 1853.

Callorhynchus elephantinus, Gronov. Syst. ed. Gray, p. 15, 1854 (Chilian waters ; Pacific).

Callorhynchus peronii, Duméril, Elasmobr. p. 694, pl. 14, fig. 4 (young), 1865.

Callorhynchus capensis, Duméril, t.c.p. 695, pl. 13, figs. 5 and 5*a* (Cape of Good Hope) ; Goode & Bean, Oceanic Ichth. p. 36, fig. 32, 1896.

Callorhynchus callorhynchus, Berg, An. Mus. Nac. Buenos Aires, iv, p. 18, 1895 ; Delfin, Cat. Peces Chile, p. 27, 1901 (temperate coasts of the Southern hemisphere) ; Waite, Rec. Canterbury Mus. i, No. 2, 1909, p. 23, pl. xvi, fig. 2 ; McCulloch, F.I.S. "Endeavour" p. 16, 1911 (Flinders Island, Bass Strait and Victorian coast).

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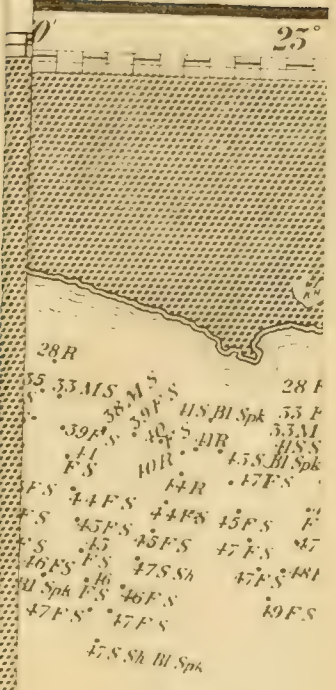
Chart showing distribution of mud, sand, &c., on Trawling grounds on S. coast.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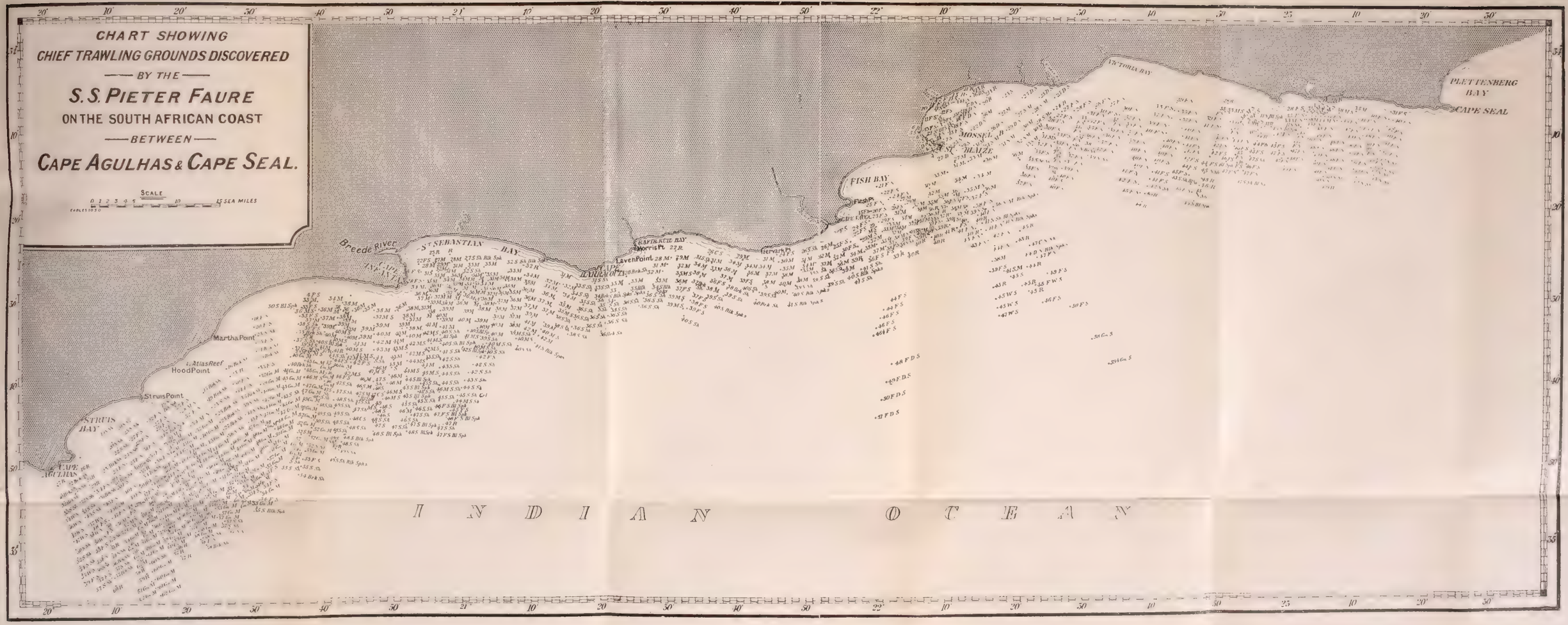
CHART SHOWING
CHIEF TRAWLING GROUNDS DISCOVERED
BY THE
S.S. PIETER FAURE
ON THE SOUTH AFRICAN COAST
BETWEEN
CAPE AGULHAS & CAPE SEAL.
SCALE
0 1 2 3 4 5 10 15 SEA MILES
Breede River
ST SEBASTIAN BAY
Morris Pt
Leven Point
Hevern Pt
FISH BAY
Fleshy Pt
VICTORIA BAY
PLETTENBERG BAY
CAPE SEAL
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